The New Zealand

Journal of Agriculture.

VOL. 47. WELLINGTON, 20TH JULY, 1933. No. 1.

THE NEW ZEALAND GRASSLAND ASSOCIATION.

SOME PRELIMINARY NOTES ON NEXT MONTH'S GENERAL MEETING.

PROMPTED to some extent by the special needs arising from the economic situation, the executive of the New Zealand Grassland Association has arranged to hold a meeting of the association at Christchurch from 15th to 17th August.

On the score of economy, although there was promise of very good support, last year's meeting was allowed to lapse. While not unmindful of the continued need for economy, both private and public, the executive of the association considers it inadvisable to allow another meeting to lapse. The changing and difficult times intensify the need for meetings of an organization with the avowed objects of the Grassland Association, which, as set down in its constitution, are :—

(1) To stimulate efficiency in the practice and science of grass-farming by (*a*) meetings, lectures, and papers, (*b*) circulation of papers among members, (*c*) educational excursions.

(2) To enable workers to keep in touch with one another's work.

(3) To foster collaboration between workers.

(4) To stimulate appreciation of the great scope for and national importance of grassland advancement.

The present position in agriculture and in the Dominion as a whole makes it extremely desirable that all work in the interests of grass-farming advancement be built on a definite framework of knowledge truly reflecting the prospective national situation. This means, among other things, that research must be suited to provide the guidance that will be called for in the future. Those responsible for the planning of research and advisory work are faced with the task of endeavouring to forecast future developments in farming so that they will be able to handle situations as they arise, and not be under the disadvantage of having to initiate investigation of a problem which could have been foreseen, when that problem is already weighing heavily upon us. It is considered that the forthcoming meeting, by bringing together, for exchange of views and experience, farming and commercial interests, technical specialists, and advisory field officers, will assist usefully in the difficult task just mentioned.

In brief, the motive behind the forthcoming meeting of the Grassland Association is preparation for the future. Prospective situations may be without parallel in the past; then they will call for immediate research so that we shall be ready with advice when it is needed. Research has so often been associated with the possibility of increased production that it is well to remember that it is not necessarily so associated, and it is realized that the research of the future in respect to grassland may have to be directed not so much towards increased production as towards cheaper production.

Origin of the Association.

Some indication of the nature of the coming meeting may be gained from the happenings which led to the formation of the Association.

In January, 1931, an informal meeting relative to grass-farming in New Zealand was held at Palmerston North. It was presided over by Mr. A. H. Cockayne, Assistant Director-General of Agriculture, and was attended by workers from the following organizations: Department of Agriculture, Department of Scientific and Industrial Research, Canterbury Agricultural College, Massey Agricultural College, and Cawthron Institute, together with representatives of the fertilizer and seed trades.

During the course of the meeting it was demonstrated that valuable results were likely to arise from the exchange of views and experience which such meetings were fitted to facilitate, and towards the close of the meeting it was agreed that in the interests of greater efficiency there is need and scope for co-operation and co-ordination in grassland work. No attempt was made by the meeting to indicate in detail how the desired co-operation and co-ordination could be secured, but a special committee, consisting of Messrs. J. W. Deem, G. H. Holford, and R. P. Connell, was appointed to report at a suitable date as to what should be done.

In August, 1931, a further meeting similar in constitution to the initial one was called by this committee to consider its report, which recommended the formation of an association consisting of members interested in the work of the acquisition and application of the knowledge needed to advance the standard of grass-farming in New Zealand. In conformity with the report of the special committee, the New Zealand Grassland Association was formed in August, 1931, and the following executive was appointed: Messrs. A. H. Cockayne (President), J. W. Hadfield, A. W. Hudson, F. L. Scrivener, and R. P. Connell (Secretary and Treasurer).

Programme for the 1933 Meeting.

In drafting the programme for the forthcoming meeting there has been special endeavour to make it reflective of the prevailing economic situation. The opening sessions will be devoted to consideration of contributions from a special economic section, in which Messrs. E. J. Fawcett, Department of Agriculture, F. R. Callaghan, Department of Scientific and Industrial Research, and D. O. Williams, Massey Agricultural College, will survey and discuss the economic situation.

Much interest may reasonably be expected to be aroused by a series of papers which promise to be of direct and practical appeal. Workers

who are to contribute to this series are Professors R. S. Alexander and F. W. Hilgendorf, and Mr. M. J. Scott (Canterbury Agricultural College), Messrs. J. W. Hadfield, E. Bruce Levy, R. B. Tennent, and N. Foy (Department of Agriculture), C. H. Hewlett (Canterbury Seed Company), W. W. Mulholland (representing the farming interests), W. A. Jacques (Massey Agricultural College), and Dr. H. O. Askew (Cawthron Institute). Contributions by Messrs. A. W. Hudson (Agriculture Department), G. H. Holford (attached to Imperial Chemical Industries, Ltd.), and L. Napier (Pacific Potash, Ltd.) will deal with subjects which promise to indicate the great scope for valuable work in the field of research relative not only to farm practice but to the methods of research itself.

The extensive attention to matters of practically immediate concern which the foregoing information may suggest is not an indication that there will be neglect of what may be called the long-time view. As already indicated, some of the basic aspects of future development will receive attention in the time devoted to the initial economic section, and this will be supplemented not only by the presidential address of Mr. A. H. Cockayne, but by Professor W. Riddet, of Massey Agricultural College, and Messrs G. A. Holmes, National Mortgage and Agency Company, Dunedin, and W. J. McCulloch and R. P. Connell, of the Department of Agriculture, in a series of papers which are designed to deal with some of the major problems that are likely to arise in the future advancement of grass-farming.

As it is anticipated that discussions following papers will be particularly valuable, a considerable amount of time is allowed in the programme for such discussions.

Whether the New Zealand Grassland Association will play the part it is designed to play depends to a considerable extent on whether it enrols the active support as members (at an annual subscription of 10s. 6d.) of a sufficient number of that large section of the community which is directly interested in grass-farming advancement. It is reasonable to expect that members will be recruited largely from among progressive farmers and their organizations, commercial interests trading in farm supplies or produce, and the staffs of organizations participating in research, teaching, or advisory work relative to grass-farming. Arrangements are being made to have copies of the papers read at the forthcoming meeting available for distribution among members, and thus those who are unable to attend the meeting are likely nevertheless to receive some direct benefit from it. The address of the Secretary of the Association is P.O. Box 112, Palmerston North.

Poultry Wheats.—The third annual report of the Wheat Research Institute remarks: "Rivet wheats are quite unsuitable for bread-baking, but they give high yields, have very elastic straw, so that they stand well on heavy land, and are reputed to be immune from the attacks of birds. It was thought worth while, therefore, to make some trials of Rivet wheats to see if they were suitable for poultry-farmers living near the towns. Three strains—Cambridge Rivet, Percival's Blue Cone, and Garton's Early Cone—were included in the analytical yield trial. Their yield was encouraging, and the best of them have this year been sown on larger areas especially exposed to the attack of birds."

THE CHEMISTRY OF WEED-KILLERS.

(Continued.)

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VARIOUS CONSIDERATIONS.

A WEED has been defined as "a plant out of place," but this is too comprehensive a statement to help much in the present series of articles, where only those weeds which are a distinct menace to the prosperity of any area will be considered. Weeds are as variable in structure as the staple plants grown for man's use or delight. A weed may be either a tree (*e.g.*, elder, willow), a shrub (blackberry, gorse, heather, St. John's wort), a perennial or biennial herb (ragwort, sow-thistles), or an annual (charlock, fathen). It may have a spreading root-system or one concentrated in a bulb, corm, or tuber. It may grow in water or on land.

Weeds propagate themselves by distributing seeds or portions of the plant broken off, which root again when they come to rest, as in the case of the willow in watercourses. Seed distribution is effected mainly by the wind, as in the composites, daisy plants with parachute seeds, and ferns with minute spores, by the transport of attractive fruits by animals and birds, as in the blackberry and brier; and by seed being carried about attached to the coats of animals, as in the piripiri and other burrs; or by projection from the seed pod by its sudden rupture in dry weather, as in the case of the gorse and broom.

Weeds may have a feeding value which enables them to be grazed to a certain amount of advantage by stock, such as some grasses, tutu and ragwort (by sheep), and thistles; or they may be wholly unattractive and poisonous, as in the case of the St. John's wort.

Among the unwanted grasses, such as tall fescue and twitch or couch, are some which are so near in character and requirements to those it is desired to grow that it is improbable any weed-killer will be discovered selective enough in its action to kill the unwanted and leave the desired grasses. When, however, it comes to dealing with the broad-leaved plant in pasture or lawns there is every hope of finding an economical and safe method of killing it out.

It will thus be seen that weeds are so diverse in their structure and requirements that it is probable each aggressive one will have to be considered experimentally by itself with a view to discovering the best means of controlling it. The procedure which therefore seems best to follow is to concentrate on one weed at a time, and as ragwort is undoubtedly the greatest weed menace at present to our pastures, and especially the health of the cattle grazing them, it is intended to discuss chemical methods of control of ragwort first, and other weeds afterwards, in the relative order of their importance.

RAGWORT CONTROL.

Ragwort (*Senecio jacobaea*) by its rapid spread and its slowly poisonous nature is at present arousing the apprehension of farmers.

The good work of the Fields Division (see J. W. Deem, in this *Journal* for May, 1930, p. 290, and following articles) in drawing attention to the efficacy of sodium chlorate in very dilute solutions as an exterminator of ragwort must be stressed. The dangers in using such a powerful explosive and inflammatory agent have, however, not been sufficiently grasped by the farming community, and many painful accidents and two fatalities have resulted from the careless use of the pure chlorate in weed control and otherwise.* It is stated that in France a proprietary mixture of chlorate and a damping agent has been generally adopted as a weed-killer in preference to the pure chlorate. If this is correct, the fact is extremely significant.

While accepting the efficacy of sodium chlorate as a weed-killer to be fully proved, it is intended to pursue the investigation in the hope of finding either some modification of using chlorate which will make it safe, or, better still, by using a new substance which would combine the efficacy of chlorate without the danger but with the growth-stimulating action of a pasture fertilizer, in order to avoid the dangers arising from the use of chlorates described in the April issue of the *Journal*.

By combining a weed destroyer which after doing its work becomes a pasture fertilizer a great advance would be made in the improvement of pastures at present suffering or threatened by the invasion of ragwort. Apart from occupying the rightful place of good pasture the ragwort has a distinctly injurious effect on the health, value, and reputation† of ruminant stock grazing on infested lands. In places ragwort is so abundant that the stock cannot avoid eating the weed with the pasture species, and there is some evidence that individual cattle may eventually acquire a liking for ragwort or develop a drug habit which prompts them to select the weed and thereby hasten poisoning symptoms.

Some experience gained at the Mamaku Demonstration Farm goes to show that when cattle are eating ragwort they fail to respond to treatment with iron ammonium citrate for preventing or curing bush sickness. This is a most dreaded possibility, as the successful farming of many large tracts of country is at present dependent on the iron remedy, now applied as limonite, for preventing bush sickness. Ragwort is undoubtedly spreading in the pumice districts, and in those which are only slightly affected with bush sickness ragwort may be an interfering factor which at all costs should be prevented from increasing in magnitude.

All this goes to show the necessity for finding an efficient, economical, and safe weapon in eradicating ragwort. It is hardly

* A Press Association message from Hamilton, dated 3rd July, reported the prosecution of a quarryman for illegally using sodium chlorate as an explosive. Tamping a mixture of chlorate and sugar with a wooden stick a premature explosion occurred whereby the defendant lost two fingers and severely injured his left arm. The Chief Inspector of Explosives had brought the prosecution with the object of giving publicity to the extreme dangers attending sodium chlorate when used by farmers for log-splitting, stumping, blasting, &c. A conviction with costs was recorded against the defendant.

† No farmer will knowingly buy animals from a ragwort-infested area when others are available from clean country. Auctioneers, to protect themselves, usually disclose the fact if any animals offered are from ragwort country, or may be asked to guarantee that they are from clean country by buyers.

probable that any single application of any weed-killer, however efficient, will eliminate all the ragwort plants in a paddock, and further there are the seeds of the weed which remain unaffected by the weed-killer and will germinate and mature in due course, necessitating further treatment. There is also the continual menace of infestation from neighbouring lands to be guarded against, so that the more one considers the question the more it becomes evident that ragwort treatment should be combined with other pasture operations, such as periodical top-dressing, until at least the weeds are under control. All bare patches left by the dying ragwort rosettes should quickly be stimulated to become covered with pasture in an attempt to stifle the young ragwort seedlings and cover up spots which may become sites for reinfestation. One of the suggestions made is that chlorate should be mixed with lime and applied at the same time as liming is performed. The objection to this in the pumice areas—particularly that of the coarsest kind of pumice soil—is that lime is not required and does not produce any apparent improvement in the pasture, and in some cases has an injurious effect in hastening the onset of bush sickness in stock. One other difficulty is that the chlorate mixed with ground limestone is difficult to transport, as it can only be conveyed in metal receptacles on the railway.

Ammonium Sulphocyanide as a Weed-killer and Fertilizer.

In the introductory article of this series (February, 1933, p. 109) mention was made of a salt of ammonia which was both a weed-killer and a fertilizer—ammonium sulphocyanide, now usually called ammonium thiocyanate. These are different names for the same compound. It is often called ammonium sulphocyanate in the United States, where its use as a potent weed-killer is now being advocated, according to a recent report received by one of the writers. This compound has fertilizing properties, being a concentrated source of nitrogen, of which it contains about 37 per cent. The English *Fertilizer and Feeding Stuffs Journal* of 9th December, 1932, contains the following announcement :—

> The value of ammonium sulphocyanide in the destruction of weeds is discussed in *Chemical Markets*, which states that the first trials were made with gas liquors containing about 20 per cent. sulphocyanide. In the course of these, which were carried out on good wheat soils, the liquor was diluted to one-fifth, one-tenth, and one-hundredth of its original concentration, and it was found that there was immediate destruction of all the species of harmful vegetation present even at the lowest concentration employed. The treatment was effected prior to the sowing of the wheat, and it was found that, so long as the sowing did not take place within two weeks after the application of the sulphocyanide, the wheat did not suffer. On the contrary, the decomposition of the sulphocyanide in the soil produced nitrogen oxides, which had a definite effect as fertilizer. It was also found that the material could be used in the form of spray for direct attack on the weeds.

Obtaining a small quantity of the pure compound, preliminary experiments were made on a farm infested in places with ragwort at Miramar, Wellington, in January last, and some tentative results were obtained which compared quite favourably with those obtained from sodium chlorate on the same farm. Further experiments were instituted at a farm in South Karori in February last. These experiments were also quite tentative, as they were conducted on a small scale, there being only a small quantity of the

ammonium compound available. Sodium chlorate was again adopted as a standard to compare the results of the treatment with other compounds. As was to be expected, sodium chlorate proved to be 100 per cent. effective so far as ragwort was concerned, but good results were obtained with ammonium sulphocyanide at the same volume strengths of solution (2½ per cent.), using a knapsack sprayer.

In the local experiments ammonium thiocyanate appeared more effective in proportion to the strengths of solution used, which were tried out in 2½, 5, and 10 per cent. concentrations. The yellowing effect on the grass was progressively greater, but the ultimate recovery of the pasture was more noticeable. Sodium chlorate in 2½ and 5 per cent. solutions had a more prolonged scorching effect, but after some months the grass began to come away quite well again.

The United States experience is that the stronger the solution (from 10 to 20 per cent.), the better the kill in the case of the more resistant weeds. Retreatment is recommended to kill any surviving plants. Of course, with the stronger doses the fertilizing action of thiocyanate is more pronounced.

Other compounds were used for the first time which showed promise, and experiments are being continued, but the results are not sufficiently advanced for further comment at the present stage.

What it is desired to indicate in the present miniature experiments is the great need for further larger-scale trials with numbers of different compounds which can be economically applied, and which will, in addition to being weed-killers, act as fertilizers either by their direct action on the growing pasture-plants or by indirect action in acting as soil sterilizers or improvers. So far as the writers are aware, there have been no attempts to try the effects of many different weed-killers on ragwort alone. Some work is essential to determine the most appropriate material to use and the right conditions for using it.

It is extremely probable, judging from experience in the United States, that quantities of weed-killer, running into thousands of tons annually, will be required in New Zealand in the future. It is, of course, extremely desirable that this should be an Empire product, and, if possible, that it should be produced in New Zealand. Ammonium thiocyanate has already been produced in the Dominion, and it is likely that, as both sulphur and ammonia are required in its manufacture, the production of thiocyanate, if it eventually proves satisfactory, may help in the production of carbon disulphide, which could be manufactured electrolytically in New Zealand were there sufficient demand to warrant the installation of a plant.

Carbon disulphide is largely used in horticulture as a fumigant and insecticide, but the quantity so used is not at present large enough to justify the expense of erecting a factory to make it locally. Ammonia is also produced in New Zealand as a by-product of gasworks, but it is more largely manufactured from air by Imperial Chemical Industries, Ltd., and imported in large quantities from Great Britain in the form of sulphate of ammonia. Sodium chlorate, on the other hand, is almost entirely derived from foreign sources.

(To be continued.)

ORCHARD SPRAYS IN NEW ZEALAND.

V. THE OIL SERIES.

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ALTHOUGH oil sprays have been used extensively in New Zealand in combating sucking insects, such as aphides, scales, leaf-hoppers, and mites, results secured have frequently been unsatisfactory. This position has arisen through our comparative lack of knowledge concerning those factors which govern their use, since until recently little more was known of oil sprays than when they were introduced upwards of twenty years ago. During the past few seasons, however, a considerable amount of investigation has been undertaken overseas with a view to ascertaining the factors by which the effects upon plants and insecticidal properties of oil sprays may be assessed. The object of this article is to review this work, to indicate as far as possible those units by which oil sprays may be measured, and to apply this information to New Zealand conditions, so that insect control may be improved and applications standardized.

History of the Development of Oil Sprays.

The first oil used as an insecticide was kerosene, which came into use about the middle of last century. At first it was applied undiluted with a brush to dormant trees, for it was not until 1880 that this oil was used as a spray. In that year Barnard, in the United States, suggested that it should be applied in the form of an emulsion, prepared with milk and diluted with water. The following year Hubbard introduced his "kerosene butter," a heavy white creamy emulsion prepared by forcing kerosene and water several times through a hand-pump. And in 1882 Hubbard introduced kerosene-soap emulsion, the success of which led to the general adoption of this spray as an insecticide (Riley, 1885).

The variable nature of the kerosenes used as sprays, the frequent plant injury experienced, and especially the indifferent insect control secured, led to experiments with heavier oils, and in 1905 Jarvis (1908) secured such satisfactory control of San Jose scale by the use of lubricating oils that within a year or two the use of these became general, resulting in the gradual abandonment of the kerosene sprays. Little progress was made in the development of these lubricating-oil sprays in the United States (owing largely to the competition of commercial lime-sulphur) until about 1920, when a serious outbreak of San Jose scale in the Middle West, and the appearance of European red mite in the East, led to their widespread use (Turner, 1931).

About the year 1924 summer applications of highly refined lubricating oils (the so-called "summer" or "white" oils) were used in California in combating scale insects of citrus trees. These oils proved so successful that they are now widely used in the United States as summer sprays for the control of insects of both citrus and deciduous trees.

In Europe and Great Britain kerosene sprays have been largely superseded by "tar washes," most of which are proprietary products, composed of emulsified tar distillates, and applied as dormant sprays at concentrations of from 6 to 10 per cent. The lubricating oils were apparently not used on a commercial scale in Britain until 1930, during which season and subsequently they have had a limited application as dormant sprays, alone or combined with "tar washes."

In New Zealand kerosene was first recommended as an insecticide by Maskell (1887, pp. 31–33); and from 1892 to 1909 kerosene-soap emulsions were given a prominent place in the Annual Reports of the Department of Agriculture. In 1906 lubricating oils were introduced by a few commercial firms, but did not at first find favour with the orchardist, owing to the difficulty experienced in their emulsification. In 1910 the Department of Agriculture, following the work of Cockayne (1910), recommended types of emulsifiers which made the application of lubricating oils relatively simple. The introduction of commercial emulsified oils in 1912 led to the addition of lubricating oil sprays to the general spray programme. Since then, and until about four years ago, winter applications of oil sprays were applied to all fruit-trees, on an average of one spray each alternate season. Summer oils were tested experimentally in 1929, and their success in combating certain pests has led to a general tendency to apply them during the early autumn for the control of red mite, aphides, and other insects. In 1931 several proprietary "tar washes" were tested, but as they have not proved superior to the petroleum oils it is doubtful whether they will become serious competitors of the latter.

Definition of Oils.

In the introduction two types of oils—petroleum oils and "tar washes"—were mentioned. Petroleum oils are used as winter and summer sprays in the United States, Canada, South Africa, Australia, and New Zealand, whereas in Britain and Europe the "tar washes" are principally employed, but as winter sprays only. As these are very different mixtures, both chemically and physically, it is necessary to differentiate between them in order that the properties of each may be discussed.

Petroleum Oils.

The petroleum oils (aliphatic, paraffin, or mineral oils, as they are variously termed) are derived from crude petroleum, a natural product procured from the ground in various parts of the world. Crude petroleum is a complex mixture of a large number of compounds, and by fractional distillation may be separated into several fractions, classified according to their boiling-point range, the more important being:—

(*a*) Benzines: These have a boiling-point range of 70° C. (or less) to 150° C. or more; and comprise the motor spirits and mineral turpentine of commerce.

(*b*) Kerosenes: The boiling-point range of these is 150°–300° C. Kerosenes are used as illuminating oils and as fuel for internal combustion engines.

(*c*) Gas oils: The boiling-point range is 250°–350° C. These form a poorly defined class of oils intermediate in character between the kerosenes and lubricating oils, and are used as fuel for Diesel engines, in the manufacture of illuminating gas, &c.

(*d*) Lubricating oils: The boiling-point range is 300° C. and upwards. Used for the lubrication of machinery and as sprays.

(*e*) Paraffin wax: A white solid extracted from petroleum oils during fractional distillation.

(*f*) Solids: Asphalt, &c., remaining in the still as residues, when the other compounds listed have been extracted.

Fractions of group (*d*), comprising those lubricating oils (and to a lesser extent the gas oils) with a boiling-point range of 300°–400° C., are employed as sprays to-day, although formerly anything from crude petroluem to light or heavy lubricating oils were used for the purpose. Naturally, the composition of such a fraction varies greatly, according to the source of the crude oil, the process of distillation employed, and the degree of refinement to which the oil has been subjected. The straight distillates, however, may be regarded as being composed of three groups of compounds—the paraffin hydrocarbons, unsaturated hydrocarbons (or olefines), and the aromatic hydrocarbons.

Units of Measurement.

Recent investigations have shown that to be effective as insecticides, yet harmless to plants, oils must be compounded to definite specifications, the units of measurement being based on certain physical constants and chemical characters. Those factors now regarded as significant are (*a*) unsaturation, (*b*) oil content, (*c*) viscosity, and (*d*) volatility. But numerous additional units have been proposed or used by different workers, most being adapted from oil specifications in use by the petroleum industry. Those regarded as valueless by recent workers are acidity, base (whether the crude oil was derived from a paraffinic or naphthenic (asphaltic) base), fire point, flash point, pour point, and sulphur content. Other factors, viewed as significant by certain workers, but by ourselves regarded as being of little value (colour, distillation range, oxidation, and specific gravity) are discussed briefly in the text.

(1) *Colour.*—Although this factor is not directly correlated with toxicity of oil sprays towards insects or plants, it has been used to differentiate between oils prepared for winter and for summer application, the former being termed "red oil," the latter "white oil." The use of these terms should be discontinued as they are misleading, since filtration or emulsification may remove the colour of a "red oil" without altering its composition. Preferable terms are "winter" and "summer" oils, defined as those oils which are suitable for use during the dormant and growing season respectively.

(2) *Distillation or Boiling-point Range.*—Recent work has demonstrated that lubricating oil fractions with a boiling-point range of 300°–400° C. provide the most efficient insecticides; and, in fact, the bulk of oils offered for sale fall within these figures (Marshall, 1930; Erb, 1932). This unit may also be used as a measure of volatility, indicating whether lighter fractions (as the kerosenes) have been blended with heavier to provide oils of certain viscosities. The distillation range was regarded by Erb (1932) as a more satisfactory unit of measurement than viscosity. He accordingly proposed grouping spray oils under five headings—"light," "light medium," "medium," "heavy medium," and "heavy"—according

to the range in volume percentages distilling off at 335° C. Determinations of the boiling-point range are, however, unnecessary, as the viscosity and volatility (or rather evaporation) give more reliable data by which the insecticidal value of an oil may be assessed. Consequently Erb's elaborate classification may be disregarded.

(3) *Unsaturation.*—Gray and de Ong (1926) found that those compounds present in lubricating oils which were removed by sulphonation (the unsaturated and aromatic hydrocarbons) were most liable to cause injury to fruit and foliage. Subsequent workers have confirmed this, so that to-day it is well recognized that the more highly refined an oil the less likely it is to cause injury when applied to trees during the growing period (Brock, 1929; Yothers and McBride, 1929; Spuler, Overley, and Green, 1931; Ginsburg, 1931; Swingle and Snapp, 1931, &c.). Consequently the greater portion of these toxic compounds should be removed from oils required for summer application. In oil refineries this is effected by the sulphonation process, in which oils are treated with either concentrated sulphuric acid or liquid sulphur dioxide, the degree of refinement being governed by the quantity of acid used and the time taken in treatment. The oils are then treated with a solution of caustic soda (for the removal of acids), washed with water, and finally air dried. The refined oil remaining after treatment (termed by American workers the "unsulphonated" or "unsulphonatable" residue) may be composed of from 50 to 100 per cent. of saturated hydrocarbons.

These refined oils are considerably more costly than the untreated distillates, as, in addition to the cost of refining, quantities of the original bulk are lost, the volume of waste increasing with the degree of refinement. Because of this manufacturers may offer oils with a minimum degree of refinement, or those which are unrefined but resemble highly refined oils in appearance. It is necessary, therefore, that the unsaturated (and aromatic) hydrocarbon content be known, with reference both to the amount of unsaturation and the percentage of unsaturateds. Three methods of measurement are available: Determination of (*a*) the percentages of unsaturateds and aromatics by sulphonation, (*b*) the iodine value, and (*c*) the heat of bromination.

(*a*) Determination of the unsaturated and aromatic content: The "sulphonation test" used by American workers as a measure of the relative safety of oils to plant tissues indicates the percentage of unsaturated and aromatic hydrocarbons present, a permissible maximum being in the region of 10–15 per cent. in oils designed for summer application, and 25–30 per cent. in those intended for winter use. The method usually employed is that outlined by Gray and de Ong (1926), in which a measured volume of oil is treated with a known quantity of concentrated sulphuric acid, and the volume not absorbed by the acid (the "unsulphonated" residue) is ascertained. From this the percentage of unsaturateds (and aromatics) is computed.

(*b*) Determination of the iodine value: This method was employed by Tutin (1932) and Austin, Jary, and Martin (1932) for the

estimation of the unsaturated (and with it the aromatic) hydrocarbon content of an oil. It is preferable to the sulphonation process, since the iodine value is correlated with the number of unsaturated bonds, and is therefore a more accurate means of measuring the harmful properties of an oil. In this process advantage is taken of the fact that under a given set of conditions iodine will combine with the unsaturated to produce saturated oils, the iodine value being indicated by the number of grams of iodine which are absorbed by 100 grams of the oil, and varying with the percentage of unsaturateds present, their molecular weight, and the number and grouping of unsaturated bonds in each molecule of the unsaturated compounds. The safety of an oil towards plants may thus be expressed in terms of its iodine value. Three methods, varying only in technical application, are available for ascertaining the iodine value of an oil: (i) Wijs, (ii) Hanus, and (iii) Huebl. The first and third methods were recommended by Tutin (1932). The Wijs method, however, is the most convenient to use, gives reliable results, and is in consequence the most generally used.

(*c*) Determination of the heat of bromination: The approximate iodine value of any oil may be determined by ascertaining the rise in temperature when a given quantity of bromine is added to a measured volume of oil, and by multiplying this figure by a given factor (5·5 to 6·0, according to the personal equation). The method is rapid but less accurate than that used for the determination of iodine value by the direct process, especially when the iodine value is low.

(4) *Oil Content.*—The concentration of oil in a spray is important, since it governs both successful insect control and plant injury. In New Zealand it has been customary to recommend applications at empirical dilutions such as 1–10, 1–20, &c. These imply that 1 gallon of oil is to be added to 9 or 19 gallons of water, on the assumption that the oil content of the concentrate is 100 per cent. As analysis of the oil sprays on the market has shown that their oil content may range from 50 to 100 per cent., it is evident that an alternative method of indicating required dilutions must be employed. The practice of expressing dilutions as percentages, employed in Europe and North America, is a satisfactory alternative, provided the orchardist is conversant with the oil content of the concentrate. With this information, and the aid of the accompanying dilution table, he should have no difficulty in applying oil sprays at the required concentration of oil.

(5) *Oxidation.*—According to de Ong (1926), when a highly refined oil is exposed in thin films to sunlight oxidation of the saturated hydrocarbons may lead to an increase in acidity, and thus (de Ong, 1928) produce foliage injury. As injury from this cause has not been demonstrated experimentally, and as oxidation has been disregarded by recent workers it is probable that it has little significance.

(6) *Specific Gravity.*—This unit would appear to have little significance, although regarded by many workers as of value. The principal disadvantages are that frequently there is little correlation between this factor and viscosity, and that it may be materially

Table of Oil Dilutions.

(To prepare 100 gallons of spray of the required concentration add the quantity of oil given in the upper figure to the volume of water specified in the lower figure.)

Oil Content of Bulk Supply, in Percentages.	Percentage of Oil Concentration required.									
	10	9	8	7	6	5	4	3	2	1
100	10·0 90·0	9·0 91·0	8·0 92·0	7·0 93·0	6·0 94·0	5·0 95·0	4·0 96·0	3·0 97·0	2·0 98·0	1·0 99·0
95	10·5 89·5	9·8 90·2	8·4 91·6	7·4 92·6	6·3 93·7	5·3 94·7	4·2 95·8	3·1 96·9	2·1 97·9	1·05 98·95
90	11·1 88·9	10·0 90·0	8·9 91·1	7·8 92·2	6·7 93·3	5·5 94·5	4·4 95·6	3·3 96·7	2·2 97·8	1·11 98·89
85	11·7 88·3	10·6 89·4	9·4 90·6	8·2 91·8	7·0 93·0	5·8 94·8	4·7 95·3	3·5 96·5	2·5 97·7	1·17 98·83
80	12·5 87·5	11·25 88·75	10·0 90·0	8·75 91·25	7·5 92·5	6·25 93·75	5·0 95·0	3·75 96·25	2·5 97·5	1·25 98·75
75	13·3 86·7	12·0 88·0	10·7 89·3	9·3 90·7	8·0 92·0	6·7 93·3	5·3 94·7	4·0 96·0	2·7 97·3	1·33 98·67
70	14·3 85·7	12·8 87·2	11·4 88·6	10·0 90·0	8·6 91·4	7·1 92·9	5·6 94·4	4·3 95·7	2·8 97·2	1·42 98·58
65	15·4 84·6	13·8 86·2	12·3 87·7	10·8 89·2	9·2 90·8	7·7 92·3	6·1 93·9	4·6 95·4	3·1 96·9	1·53 98·47
60	16·7 83·3	15·0 85·0	13·3 86·7	11·7 88·3	10·0 90·0	8·3 91·7	6·7 93·3	5·0 95·0	3·3 96·7	1·66 98·34
55	18·2 81·8	16·4 83·6	14·5 85·5	12·7 87·3	10·9 89·1	9·1 90·9	7·3 92·7	5·4 94·6	3·6 96·4	1·81 98·19
50	20·0 80·0	18·0 82·0	16·0 84·0	14·0 86·0	12·0 88·0	10·0 90·0	8·0 92·0	6·0 94·0	4·0 96·0	2·0 98·0
Empirical formulæ*	1–10	1–11	1–12	1–14	1–16	1–20	1–25	1–33	1–50	1–100

* Based on the assumption that all oils are of 100 per cent. concentration.

These figures are taken to the nearest fraction. In using the table the orchardist has but to ascertain the quantity of spray his tank holds and to add the required proportion of water, then the oil in the form of a cream-like emulsion. It is sufficient to take the oil to the nearest quarter-gallon (save in the greatest dilutions) and the water to the nearest whole gallon.

affected by blending or by the unsaturated content. The terms "light," "medium," or "heavy" applied to oils on the basis of their specific gravity are therefore misleading and should be discarded.

(7) *Viscosity.*—It is now generally recognized that the insecticidal value of an oil is governed largely by its viscosity. This was

demonstrated by de Ong, Knight, and Chamberlain (1927), and has since been confirmed by most other workers. The viscosity (or, more correctly, the relative viscosity) of an oil may be defined as its rate of flow, and is measured by the time in seconds that a definite volume of the oil, at a specified temperature, takes to flow through a definite orifice.

Viscosity is measured with an apparatus termed a viscometer, of which there are three types available: (*a*) The Engler, used in Europe; (*b*) the Saybolt Universal, used in North America; and (*c*) the Redwood I, used in the British Empire. Unfortunately, these three types give materially different readings and, as there is no convenient factor for converting the readings of one instrument to that of another (tables being necessary for the purpose), it is necessary to specify a standard instrument. As the Redwood viscometer is in general use throughout the British Empire it is recommended that the viscosities of spraying oils offered for sale in New Zealand be stated in Redwood I seconds. The process of determination is outlined by the Institute of Petroleum Technologists (Anonymous, 1929, pp. 58–61). As the viscosity of an oil is materially affected by temperature it must be determined at some given standard temperature. In the United States this has been fixed at 100° F., whereas in England Tutin (1932), and Austin, Jary, and Martin (1932) employed 70° F. The former temperature has the advantage of being nearer the actual working temperature when summer oils are employed, and for this reason the temperature for the test has been fixed at 100° F.

As the viscosity of an oil is readily and accurately determined, and as it appears to afford a measure (in conjunction with volatility) of the insecticidal value of an oil spray, it should be used in preference to the distillation range or specific gravity, and specified in place of such indefinite terms as "thin," "medium," "thick," or "light," "medium," and "heavy."

(8) *Volatility.*—The rate of evaporation of an oil, when exposed as a film, was considered by de Ong (1928) to be of significance in that it affected the permanence of the oil film upon the tree. And as both insect control and plant injury are affected by the degree of permanence of this film (see below, under the section on effects of oils upon insects), it is apparent that volatility is almost as significant as viscosity.

Two methods are available for its measurement: (*a*) The evaporation test of de Ong (1928). In this a weighed quantity of the oil is placed on a special asbestos sheet, which is then suspended in an oven held at a constant specified temperature and weighings made at intervals over twenty-four hours, the evaporation loss being given in percentages; (*b*) the standard volatility test (Institute of Petroleum Technologists, No 17, 1929), in which a given quantity of oil is exposed in a specified type of container at a given temperature, weighings being made at intervals and the loss given in percentages. Numerous modifications of the process are used by different organizations.

In the evaporation test of de Ong the oil is spread out in a thin film, and conditions thus approach more closely to those

obtaining in practice. In our opinion, therefore, it is a more satisfactory test of volatility than the standard method.

Tar (Aromatic) Oils.

Although tar distillate sprays (the so-called "tar washes") are in general use in Great Britain and Europe as winter sprays, they have not been used commercially in other countries. During the past three seasons they have been tested on an experimental scale in the United States (Parrott, *et al.*, 1931; Hough, 1932), South Africa (Andries, 1932), and New Zealand; but results secured have not justified their recommendation in preference to petroleum oils as winter sprays.

Sprays of this type are prepared by the emulsification of certain tar fractions, which are derived from the destructive distillation of wood, coal, and peat. This process leads to the production of very numerous organic compounds, which are separated by fractional distillation into the following groups:—

(*a*) Benzines (and related homologues, as toluene, xylene, &c.): These aromatic hydrocarbons have a boiling-point range of 40°–150° C., and are used as motor spirits, fat solvents, &c.

(*b*) Phenols (the so-called middle oil): These have a boiling-point range of 150°–210° C., and are used as disinfectants, insecticides, &c. Naphthalene is also procured during the fractionation of the phenols.

(*c*) Creosote oils: These have a boiling-point range of 210°–270° C., and are used as wood preservatives and insecticides.

(*d*) Anthracene oils: The boiling-point range is 270°–400° C. These oils, like the preceding, are used as wood preservatives and insecticides.

(*e*) Pitch: The semi-solid residues left in the still.

The proprietary tar distillate sprays have a wide boiling-point range, extending from 150° to 380° C. (showing that they are derived from groups (*b*), (*c*), and (*d*)), and vary greatly in composition according to their source (whether derived from coal, peat, or wood distillates) and the processes of distillation employed (whether by horizontal or vertical retorts). It is evident, therefore, that they are complex and dissimilar mixtures, and that their use must lead to varying results being secured in the field, unless they are prepared to definite specifications. Unfortunately, these specifications cannot be indicated as yet, since little work on these lines has been undertaken; but the recent investigations of Tutin (1928) have given some promise that this position may be soon remedied.

Tutin attempted to ascertain those compounds present in distillates of this type which were most effective as insecticides. He used a vertical retort coal tar with a boiling point of 190°–360° C., containing nearly 20 per cent. of tar acids (which consist mainly of hydroxyl derivatives of aromatic hydrocarbons, as phenols, cresols, &c.). The tar acids were separated from the neutral oils and divided into two fractions—"low phenols" (b.p. 190°–220° C.), and "high phenols" (b.p. 280°–360° C.). The neutral oils were likewise separated into two fractions—"low neutral" (b.p. 190°–280° C.), and "high neutral" (b.p. 280°–360° C.). All were emulsified and tested as dormant sprays against the eggs of the winter moth, the "high neutral" oils alone proving effective, due to the permanency of the oil film produced.

Vegetable Oils.

From time to time attempts have been made to use certain vegetable oil sprays, prepared from castor, olive, linseed, rape, coconut, or cottonseed oils. But, owing to the poor results secured when compared with the petroleum oils, their use has seldom been carried beyond the experimental stage. Further discussion is therefore unnecessary.

Emulsifiers and Emulsions.

Petroleum Oil Emulsifiers.

Oil sprays cannot be applied in the concentrated form, owing to mechanical difficulties of application, the prohibitive cost, and the probability of producing severe injury, even to dormant deciduous trees; consequently they must be diluted before application with some convenient and cheap medium, as water. Oil and water cannot be mixed unless the oil is treated with an emulsifier; for, although when shaken together the oil is broken into globules which are dispersed in the water, as soon as agitation ceases the globules rapidly coalesce, and, being lighter than water, rapidly rise to the surface to form a continuous layer.

Emulsifiers.—The role of the emulsifier is to keep the oil particles dissociated, either temporarily or permanently, so that the mixture of oil and water can be deposited on the tree, the water being used merely as an agent of dilution. It achieves this by forming, or by helping to form, a film around each oil globule, which prevents coalescence of each with its fellow, forming an oil-in-water emulsion. The nature of the surrounding film, whether readily broken or not, is determined largely by the type and quantity of the emulsifier.

Three classes of oil sprays are offered for sale—(1) straight unemulsified oils, (2) miscible oils, and (3) stock emulsions.

Straight unemulsified oils were at one time the only type available, and were inconvenient to employ in that before use they had to be emulsified. As they have been replaced by the other types listed, further reference to them is unnecessary.

Miscible oils are characterized by the fact that the emulsifier employed is dissolved in the oil, giving them the characteristic clear appearance of straight oils. They form the bulk of the commercial oils available on this market, and possess the advantages of being stable at low temperatures, mixing readily with water, and having the high oil content of 90–95 per cent. The emulsifiers used in their preparation fall into three classes: (*a*) Oleic acids or other fatty acids; (*b*) sulphonated animal, mineral, or vegetable oils with an alkali; and (*c*) soaps (discussed in the next section) dissolved in cresols.

Stock emulsions appear as white (sometimes pink) creamy pastes, and contain from 15 to 50 per cent. of water. They are true emulsions, since the oil globules are permanently dispersed in water; consequently their application merely entails dilution to the required amount. Two general types of emulsifiers are used in their preparation:—

(*a*) Soap emulsifiers: In these an alkali (ammonia, potash, or soda) is combined with an oil (animal oil, as whale or fish oil; vegetable oil, as castor, coconut, cottonseed, linseed, mustard, olive, peanut, rape, soya-bean oil, or resin) and water.

(*b*) Non-soap emulsifiers: These may be finely divided materials, such as diatomaceous earth, flour, hydrated lime, or kaolin; or colloids, as casein (with lime to render it soluble), gum arabic, glue, white of egg, &c.

Stock emulsions are further classified according to the methods of preparation employed: (*a*) Boiled-soap stock emulsions, (*b*) cold-soap emulsions, and (*c*) non-soap emulsions.

Boiled-soap emulsions are prepared by boiling together the oil and a soap emulsifier (usually at the rate of 1 lb. of soap to each gallon of oil) with or without additional water, the mixture being agitated thoroughly. Cold-soap emulsions are prepared by mixing without heat the soap emulsifier and oil. And non-soap emulsions are prepared by mixing together a non-soap emulsifier and oil. Mixing is usually performed by passing the emulsifier and oil several times through a hand or power pump.

In the concentrated form the miscible oils are the most stable, and when properly prepared they may be stored for several seasons. Next in order come the boiled-soap emulsions, for under normal conditions these will remain stable for twelve months or more without breaking (breaking being indicated by the presence of free oil on the surface), and this period may be extended considerably by the aid of stabilizers. Cold-soap and non-soap stock emulsions remain stable for but a short period, ranging from a few days to a few weeks. The last can be rendered fit for use by again passing the mixture through the pump; but the cold-soap stock may form a reversed emulsion on keeping, and thus prove difficult to handle.

Owing to the disadvantages of the cold-soap and to a lesser extent the non-soap stock emulsions, most, if not all, oils on this market are either miscible oils or boiled-soap stock emulsions.

Emulsions.—The emulsions produced when these emulsified oils are diluted and applied to the tree may be of a "permanent" or "quick-breaking" type, the former being derived from miscible oils or boiled-soap stock, the latter from the non-soap stock and to a lesser extent the cold-soap stock emulsions. The size of the globules of oil are likewise affected by the emulsifier employed. Thus, according to Swingle and Snapp (1931), these average 1, 3 to 5, 4 to 6, and 9 to 15 microns, according to whether the emulsion was prepared from a miscible oil, boiled-soap stock, cold-soap stock, or non-soap stock respectively.

There would appear to be some correlation between the size of the oil globules and the stability of the emulsion, the most stable emulsions containing the smallest globules. And as these two factors are held to play a part in affecting toxicity of oil sprays to insects and plants, it is evident that the type of emulsifier employed should be given consideration.

Tar Distillate Emulsifiers.

The preparation of stable emulsions of the tar distillates has been the subject of considerable investigation at Long Ashton by

Smith (1927), Tutin (1928), and Staniland, Tutin, and Walton (1930). These workers found that emulsification of tar distillates was possible with soap emulsifiers only when certain tar acids were present. Castor-oil soaps (alone of the soaps tested) produced a satisfactory miscible oil when upwards of 15 per cent. of tar acids of the nature of cresols were present; and as the acid content was increased other (inferior) soap emulsifiers could be employed. Below this amount of tar acids the most satisfactory emulsifier proved to be a mixture of equal parts of castor oil and resin soaps.

The neutral oils could not be emulsified with any of the soaps, but were satisfactorily treated with the following "two-solution" emulsifier. A proprietary sulphonated oil (Agral W B) was mixed with the neutral oil (10 parts by volume of the former to 90 parts of the latter), the mixture poured into the required amount of water in the spray tank, and finally a given quantity of caustic soda added after being dissolved in a little water. The alkali was found necessary to effect complete emulsification, and was used at the rate of 2 oz. per gallon of the concentrate containing 10 per cent. of the sulphonated oil.

Emulsions prepared by either process are comparable with those secured from miscible petroleum oils, being of the permanent type containing minute oil globules.

(To be concluded in next month's issue, with sections on the Effect of Oil Sprays on Insects and Plants, and Suggestions for the Use of Oil Sprays.)

PRECAUTIONS FOR MANUFACTURE AND USE OF LIMONITE AS SHEEP-LICK.

LIMONITE for use as a sheep-lick should be ground to an extremely fine powder. Recent samples of the Whangarei product—which has been found so successful in the prevention and cure of bush sickness—are so fine that 80 per cent. of the powder will pass through a sieve of 200 meshes to the linear inch (40,000 holes to the square inch), and contain 65 to 75 per cent. of hydrated iron oxide. Sheep eat this readily when mixed with salt, but they refuse to take, with any regularity, limonite which is gritty to the touch.

As indicated in the article "Control of Bush Sickness in Sheep," published in the *Journal* for June, 1932 (pages 368–69), limonite for use as a stock lick must be free from grittiness, and must not have been heated in the manufacture sufficiently to make it insoluble. In practice it will be advisable to avoid driving off the combined water in drying the limonite preparatory to grinding it.

—B. C. Aston, Chief Chemist, Department of Agriculture.

New Zealand Cocksfoot.—A good example of the superior pasture qualities of New Zealand cocksfoot has been provided at Gore Experimental Area, where plots of Akaroa, Plains, and Danish seed were sown four or five years ago. Recent observations showed little cocksfoot left in the Danish plot, whereas the New Zealand plots were excellent, with Akaroa the better of the two.

OCCURRENCE OF DRY ROT ON RAPE AND CHOU MOELLIER IN THE FIELD.

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THE dry-rot fungus, *Phoma lingam*, has been collected recently on crops of chou moellier and rape growing at Mangaweka, and on the former host at Maraekakaho, Hawke's Bay. Isolations made from lesions or "cankers" on the stems have yielded Strain IIB of *Phoma lingam*, the most virulent of the strains yet obtained. This is the first record in New Zealand of dry rot occurring on these two hosts in the field, and the occurrence is of particular interest in regard to the carry-over infection of swede crops.

FIG. 1 (LEFT). DRY-ROT LESION ON CHOU MOELLIER STEM.

FIG. 2 (RIGHT). DRY-ROT LESION ON RAPE STEM, SHOWING INTENSE PYCNIDIAL FORMATION.

[*Photos by H. Drake.*

One field in question was broken out of grass for the first crop of swedes in 1930–31, and was followed in 1931–32 by a crop of rape. In 1932 it was sown with a mixture of chou moellier and swedes. On inspection in May, 1933, the swedes had, practically without exception, succumbed to dry rot, while the chou moellier, though fairly vigorous, showed numerous stem cankers similar to that shown in Fig. 1.

An adjoining field carried a crop of rape which at the date of inspection had been twice fed off, leaving only the stems. Almost every stem showed a dry-rot lesion extending downwards from the nibbled top, as in Fig. 2. Were this area to be sown in swedes next year there is little doubt but that early and severe dry-rot infection would occur. Rape and chou moellier must therefore be considered as dangerous crops to precede swedes or turnips in a short rotation in the same or neighbouring fields.

EFFECT OF SHEARING ON HAIRINESS IN THE FLEECE OF THE ROMNEY LAMB.

K. M. RUDALL, National Research Scholar, Massey Agricultural College, Palmerston North.

IN order to judge the hairiness of a given fleece one must be aware of the effects of non-hereditary influences such as shearing. The purpose of the present work on lamb's wool is twofold: to find out whether shearing has any medulla-producing effect; and to study the extent to which medullation occurs after shearing compared with the amount of hairiness which is produced in the first few months after birth.

Dry(1), working on animals all older than lambs, gives the results of the differential shearing of moderately hairy animals. A number of hoggets and full-mouth ewes were shorn in the spring on one side but not on the other, and in the great majority the wool grown during the succeeding two months was perceptibly more hairy on the shorn than on the unshorn side. But what effect shearing might have on lamb's wool could scarcely be inferred from results for older animals. What hairiness is present in the tips of the lamb's coat can best be described as the initial burst of hairiness, and shearing takes place at a time when the early vigour of medulla production is either spent, being reduced, or about to be reduced.

Besides having a distinct bearing of economic importance, the present work adds to the knowledge that has been accumulating during the last thirty-five years on the effects of cutting and shaving mammalian hair. Remesow working on dogs and rabbits, and Schifferdecker and Bischoff working on dogs, cats, and pigs, arrived at conflicting conclusions. However, the more accurate results of the latter workers show no increase in growth rate following clipping. Trotter and Danforth have worked on human hair, and all evidence confirms the view that shearing has no effect on the amount, length, diameter, or pigmentation of hair(2).

Two experiments on sheep are reported from the Texas Experimental Station(3), and these show that slightly more wool and more yolk are produced as a result of shearing twice a year. Hence in all these experiments on the cutting of mammalian hair, carried out on such a representative series of animals, in no case, barring that of the sheep, has an effect due to clipping been satisfactorily demonstrated. The coat of the domestic sheep, however, is exceptional in that the growth of fibre is continuous, not periodic. The effects described in this article are considered as referring to a component part of the fleece—namely, the curly-tip fibres, which are more numerous than the halo-hairs or sickle-fibres. At present there is no information as to the effect of shearing on these two latter fibre types, or on the very fine fibres that commence to grow after birth.

The Experiments at Massey Agricultural College.

Just before shearing-time sixteen crossbred lambs of Romney type were selected from among the "experimental" and "flock" lambs by examining "back" and "side" samples in benzol(4). (By "back" is meant the position along the backbone at the level of the last rib; by "side" is meant the position at the point of the last rib.) Two classes were considered: (1) Those showing no hair in the tips; (2) those with a distinctly hairy tip, but showing a considerable or complete reduction in hairiness before shearing-time. In each class there were three different treatments. Some animals were left unshorn; some were completely shorn; some were completely shorn on the left side, while a large tuft 1 ft. or more in diameter was left on the right side. This treatment is referred to as differential shearing.

The ages of these lambs at the time of shearing—the middle of December, 1932—varied from three months and a half to four months. A complete series of samples was taken from "back" and "side" at shearing, and the new growth of wool was allowed to continue for three months and a half. In April, 1933, the second samples were taken. From those animals which had been left unshorn or had been completely shorn merely a further series of "back" and "side" samples was cut. A more elaborate system of sampling was employed in the case of the differentially shorn animals:—

(*a*) A long sample running horizontally from britch through the standard "side" position to foreleg, on the left or shorn side—*e.g.*, Fig. 2*a*.

(*b*) A similar horizontal sample running from britch to foreleg, through the tuft on the right side. Fig. 2*b*.

(*c*) A long sample in the vertical plane, running from below the "side" position on the left, over the "back," through the unshorn tuft, to a corresponding point below the right "side" position. Fig. 2*c*.

All samples were spread out uniformly and examined in benzol with the naked eye. Charts were made of each observation, and these are summarized below.

(1) The Six Lambs Showing no Hairy Tip on Back or Side before Shearing-time.—Two of the lambs remained unshorn, and no trace of hairiness appeared in the back or side samples. Two other lambs were completely shorn, and no hairiness appeared subsequently. One

of these lambs had the merest trace of medulla restricted to the original tips of the fleece, but no reappearance was observed by April. Two further lambs were differentially shorn, and again it was clear that by shearing wool showing little or no hairy tip no visible medullation resulted.

(2) The Ten Lambs showing Hairy Tip on Back and Side before Shearing-time.—The hairiness of the wool in lambs that are not subjected to an abnormal influence such as shearing is summarized by Dry(1) in his study of hogget fleeces. Where medulla becomes reduced in amount (or ceases) at any level save the crisis level—that is, either higher or lower than this level—the subsequent growth of fibre takes the following definite course: There is no increase (or revival) of medulla earlier than late winter or early spring, after which time there is in many animals an increase in hairiness (or a restoration of medulla formation).

Three lambs were completely shorn. In the one case the back was more hairy than the side before shearing. The post-natal tip was considerably hairy, and thereafter the amount of medulla was very much reduced for some time before the crisis level, which normally occurs about the third month (Fig. 1*a*). After shearing, the tips became strongly medullated again (Fig. 1*b*), more so at the back

FIG. 1. PHOTOGRAPH OF WOOL SPECIMENS IN BENZOL.

a From the back of a lamb, before shearing. *b* The same position after shearing. *c* From the back of a second lamb, which was left unshorn; an entire growth of seven months is shown, but the lower part of the staple does not show the hairy band exhibited in *b*.

[*Photo by P. McMahon.*

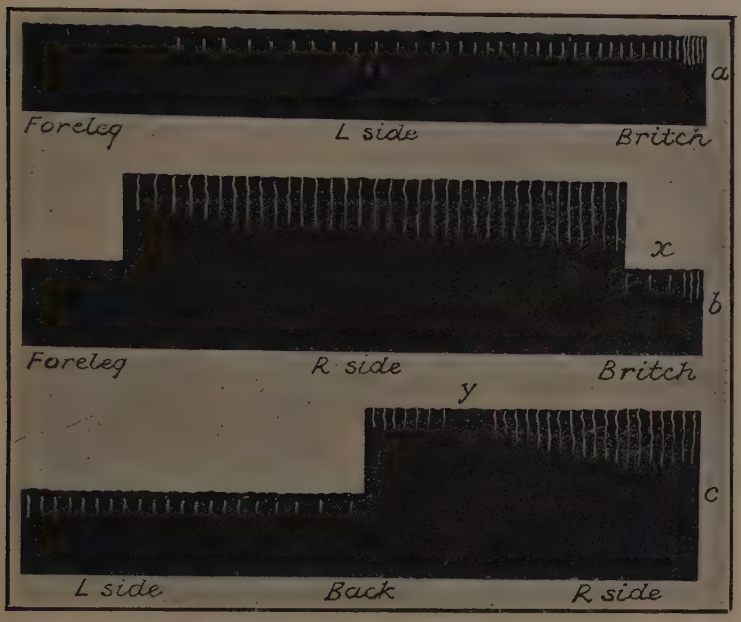

FIG. 2. CHART OF A DIFFERENTIALLY SHORN LAMB.

The black background denotes the form of the samples of wool. The white lines represent the hairiness present. The length of the lines indicates the duration of the medulla. The density of the lines gives an indication of the number of fibres medullated.

a A long sample running from britch to foreleg on the left or shorn side. L side = standard position on left side.

b A long sample running from britch to foreleg on the right side where a tuft of wool 1 ft. in diameter has been left unshorn. R side = standard position on right side.

c Sample, in the vertical plane, running from below the left side position, over the back, to below the right side position.

than at the side. After about six weeks this hairiness was completely reduced, but earlier on the side than on the back. Fig. 1*c* is a comparison staple from an unshorn lamb.

The other two lambs possessed strongly hairy tips very similar at back and side positions, but in this case the hairiness was completely reduced some time before the crisis level. In both these lambs hairiness reappeared after shearing, but only on the side. The new tip was distinctly medullated for a short distance, and thereafter hairiness was maintained throughout the length of the staple in a much reduced degree. Dry(1) has noted in his study of successive fleeces that where medulla is confined to a short apical region the same part of the second fleece will sometimes, but not always, have less medulla or none at all, and the reduction may be greater on the back than on the side. The present work on lambs has thus extended Dry's observations, and emphasizes the more general occurrence of this difference in the behaviour of back and side.

Six lambs were differentially shorn, and included those with hairiness restricted to a short apical region, and those with hairiness extending with early or later reduction, up to shearing-time. What results after shearing depends somewhat on the distribution of medulla in the staple before shearing :—

(*a*) Where the hairiness of the lamb's coat was only moderately coarse and restricted to a short apical region, the tips following shearing were hairy, but all medulla was confined to a short apical portion of the new growth. (Fig. 2.)

(*b*) Where the tips of the lamb's coat were more extensively medullated, a distinctly hairy band generally followed for a short time upon shearing, and thereafter hairiness was generally maintained for a short time, but reduced in amount. (Fig. 3.)

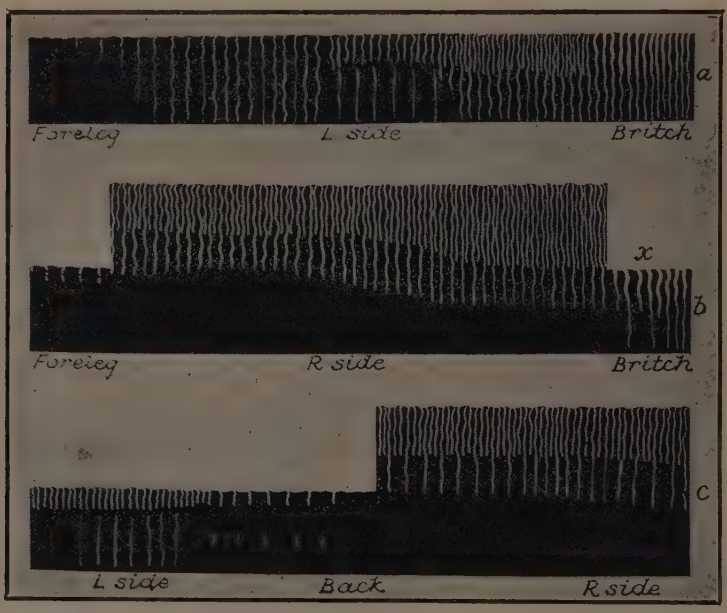

FIG. 3. CHART OF ANOTHER LAMB—MORE HAIRY THAN FIG. 2.

a, *b*, and *c* as in Fig. 2. In *b*, (*x*) is a region, just outside the posterior junction of shorn and unshorn areas, where there is reduction in hairiness as compared with the corresponding position in *a*. In *c* the tips on the left side are seen to be more hairy than at a corresponding level on the right side. A similar difference between shorn and unshorn areas is seen when comparing *a* and *b*.

(*c*) Where hairiness in the lamb's coat had been reduced (or had disappeared) for a short time, and had then increased (or reappeared) just at shearing-time, little or no effect due to the shearing process could be detected. (Fig. 4.)

These experiments indicate that various follicle-groups are affected in different ways by shearing. Some refuse to be upset or pushed into producing hairy fibre by the process of shearing ; some readily

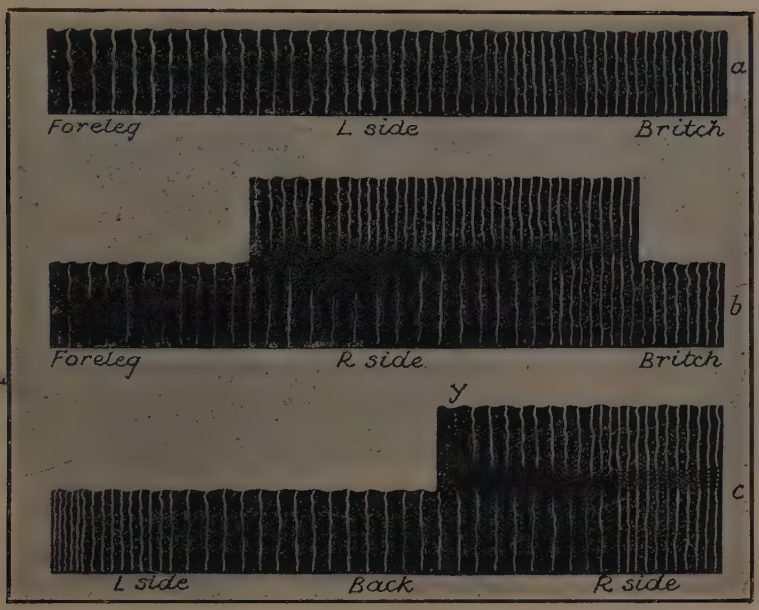

FIG. 4. CHART OF A VERY HAIRY LAMB.

a, *b*, and *c* as in Fig. 2. Hairiness was just beginning to increase again at the time of shearing. In such a case there is little or no difference between shorn and unshorn sides. In *c*, (*y*) is a region on the back where infilling has occurred.

produce hairy fibre and continue to do so for a longer or shorter time; and some were going to produce medulla in any case and the effect of shearing is not apparent here.

SPECIAL FEATURES RELATING TO SHEARING.

(1) Size of the Shorn Area.—Long and narrow samples (not more than 1 in. in width) had been cut in January, in an identical fashion to those taken in April. The short lengths of wool (grown following the January sampling) were examined along with the samples taken in April, and the fibres that had been cut were not found to differ from the uncut fibres immediately surrounding them. Hence it is concluded that the medulla-producing effects of shearing, as described above, are only apparent when a sufficiently large area is shorn.

(2) Sheltering Effect of the Tuft.—In the case of the differentially shorn lambs, the tuft 1 ft. in diameter has a definite sheltering effect—within the tuft the fibres show less medullation than at corresponding positions on the left or shorn side (Figs. 2*b* and 3*b*). One question that this raises is whether the effect of shearing is one of temperature change, and this could best be answered by keeping the shorn fleece in place by some suitable covering.

(3) Invasion Effects.—The effect of shearing is not a local one. Parts left unshorn may become hairy after the date of shearing, as if by invasion. This is noticeable at the junctions of shorn and

unshorn regions, where hairiness extends from the shorn area into the tuft, decreasing in amount from the margin inwards (Fig. 5). Or the reverse process may be more prominent, and hairiness may be reduced in an area that is in close proximity to an unshorn area as at *x*, Fig. 2*b* and 3*b*. Hence shearing may induce hairiness just inside the tuft, or in other cases the presence of the unshorn tuft may reduce the medulla-producing effects of shearing.

Taking these first three effects together, it is not possible to interpret the production of medulla as the result of a direct stimulating effect that the shearing process may have upon the follicle. The somewhat diffused hairiness that is produced suggests some change acting through the cutaneous nervous or circulatory system. This might well be an effect of the reduction of temperature due to removal of the fleece.

(4) Origin of small Clumps of coarsely Hairy Fibres.—At the junction of shorn and unshorn regions coarsely hairy fibres were generally to be found just inside the shorn area. The distal or outer ends of these fibres possess the tapering points that are characteristic of newly arising fibres. There are reasons for believing that these fibres are grown in follicles from which the original fibres had been pulled. In the first place, it is observed that the long uncut fibres at these positions stand comparatively thinly in the skin. In the second place, in the tips of some of them there is a special feature which is significant. This is a slight swelling, just below the extreme point, showing a touch of the smoky condition described by Elphick(5), who refers to Mark(6). Dr. Dry tells me that tips like these are very rare, except where there is reason to think that pulling, or shedding of fibres in a way considered abnormal, has taken place. He has found them in some of the fibres growing on marked patches from which the wool had been purposely pulled. The evidence suggests that the new hairy fibres shown in Fig. 6 owe their origin to the pulling-away of the shorn fleece from the unshorn tuft. In this process small bundles of fibres may accidently be torn out from the unshorn region.

The hairiness of the new fibres varies in different regions of the same animal, and in corresponding regions of different animals. In the case of the non-hairy-tipped animals no pronouncedly hairy fibres were found as above. Moderately hairy fibres were found at the junction towards the britch on the right side, while at the mid-back and the anterior junctions new fibres were found that showed either just a trace or no medulla at all.

INFILLING.

Taking a view along any line in the fleece—say, A to B—no very sharp variation in the degree of hairiness will normally be seen. The hairiness will generally decrease or increase gradually from A to B. But on rarer occasions this regular gradient is broken, as is seen at *y*, Figs. 2 and 4. Microscopical examination reveals that this non-appearance of hairiness when observed in benzol is due to infilling of the usually hollow (air-containing) medulla. Where the amount of medulla in a staple is being denoted as a percentage, the existence of infilling may greatly complicate the result. The urgency of studying

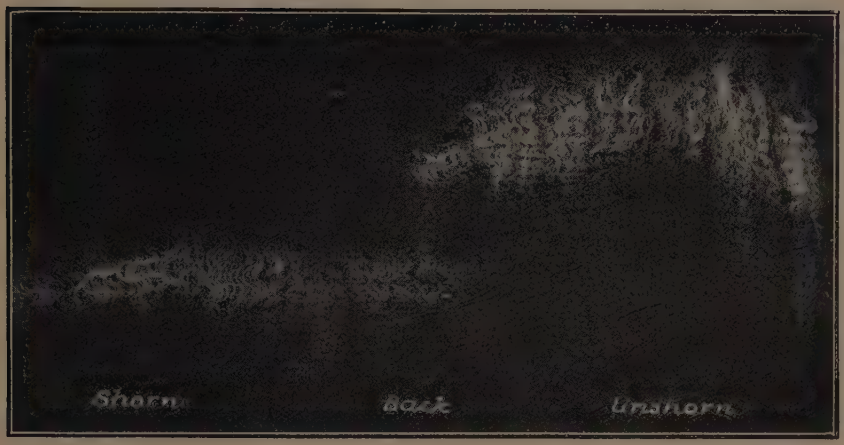

FIG. 5. PHOTOGRAPH OF WOOL SPECIMEN IN BENZOL.

The wool grown on the left or shorn side is clearly more hairy than on the right or unshorn side. Along the back, where these two sides meet, there is a spreading of hairiness from the shorn side into the unshorn tuft. This is referred to as the "invasion" effect.

[*Photo by P. McMahon.*

FIG. 6. PHOTOGRAPH OF WOOL SPECIMEN IN BENZOL.

The photo shows the junction of a shorn and an unshorn region, with a dense clump of newly arising and coarsely medullated fibres just inside the unshorn region.

[*Photo by P. McMahon.*

this matter was realized by Elphick, who performed experiments in an attempt to discover the causes of infilling. In the present cases, where large sections of the fleece—*e.g.*, long narrow samples running from britch to foreleg—are spread out in benzol, sharp discontinuities such as are due to infilling can be easily recognized, and allowance can be made for them.

Summary.

(1) In the case of lambs with very little or no hairiness in the tips of the fleece, shearing is not found to cause the appearance of medulla. This emphasizes once again the importance of little or no hairy tip in the lamb's fleece. We are here dealing with a group of follicles that will not be pushed into producing hairy fibre under the provocation of shearing.

(2) Of the completely shorn lambs with a distinctly hairy tip in the fleece, all showed an increase of hairiness after shearing. In each case the side positions were hairy tipped in the new growth, but two of the animals failed to produce hairy tip on the back. There is a general tendency for hairiness to be kept up better on the side than on the back.

(3) Of the differentially shorn animals (hairy tipped), in each case more hairiness appeared on the shorn side than on the unshorn side.

(4) Provided that the original coat showed a considerably hairy tip, a new hairy tip would generally follow upon shearing. This new hairiness is strongest at the tip, and thereafter is reduced to disappear after a longer or shorter time.

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Potato Moth attacking Cape Gooseberry.—Cases of a small caterpillar attacking Cape gooseberry plants by boring into the stems were reported from Motueka and Hastings during the past season. The pest has been identified by the Entomologist, Plant Research Station, as the potato tuber moth (*Phtorimaea operculella*).

Wheat Introductions.—The third annual report of the Wheat Research Institute states: "The large-scale introductions, which were imported from those countries whose conditions seemed similar to ours, do not give promise of much success; several wheats from Kansas were kept for further trial, but they all perished during the spring drought of 1931 and were not harvested in 1932. The introductions of new wheats from all over the world have now reached the number of 2,700. Most of these are quite useless for New Zealand conditions, but about a dozen are being tried for yield against Solid-straw Tuscan by the rod-row method, and a few dozen more are being grown in sufficient quantity to provide grain for milling and baking trials. Of most of these it is not expected that they will ever be any use in themselves, but they may provide suitable parents for crossing with New Zealand high-yielding varieties."

UTILIZATION OF NATURAL HEAT RESOURCES IN THERMAL REGIONS.

FURTHER INFORMATION FROM VARIOUS SOURCES.

J. A. BRUCE and F. B. SHORLAND, Chemistry Section, Department of Agriculture.

IN an article published in this *Journal* for November, 1932, the present writers directed attention to some recent developments in the utilization of subterranean heat. It was shown that in at least three localities — Tuscany, California, and Iceland — considerable attention had been given to the harnessing and developing of natural heat for the needs of mankind.

The possibility of utilizing the stupendous heat energy of the interior of the earth has frequently been considered by scientists, but the technical difficulties involved are such as to hinder any immediate commercial applications. In point of fact, to obtain a continuous heat yield equivalent to 4,000 horse-power it would be necessary to bore into the earth a hole 30 miles deep and 2 ft. in diameter. In post-volcanic regions, however, the internal heat of the earth is close to the surface, and can be satisfactorily harnessed and applied under the appropriate conditions to the needs of industry and agriculture. In this connection it might be supposed that the sinking of tubes into the hot soil surrounding volcanoes would provide a useful means of exploiting natural heat. Experience has shown, however, that heat transmission, even from incandescent lava, is exceptionally poor, so that enormous heating surfaces would be required to be worth utilizing for industrial or agricultural purposes.

THERMAL RESOURCES OF THE WORLD.

Among the most important thermal areas of the world may be mentioned the Katmai district of Alaska, the Sonoma County of California, Yellowstone Park, parts of Arkansas, Oregon, and Nevada (all in the United States of America), the Tatio region in Chile, and areas in Bolivia and associated countries of the Andes where there is post-volcanic activity, the volcanic areas of Java, Tuscany (in Italy), Iceland, Greenland, and New Zealand.

Increasing attention has been and is being directed towards the development of the resources in a number of these thermal regions, mainly arising from Prince Conti's fundamental achievements in establishing steam-power units and boric acid recovery plants at Larderello, in Italy. It is a noteworthy fact that Japanese scientists and engineers have of recent years been among the most closely interested visitors to Prince Conti's geothermal plant, and it is quite possible that these progressive people are already making a beginning in the exploiting of their own extensive thermal areas, although the recent catastrophic earthquakes would doubtless tend to hinder developments. However, the point that should be borne in mind is that the Japanese have become seized with the importance of developing natural heat areas for agriculture and industry at present used as playgrounds for tourists.

They have visions of developing their thermal areas in a similar way to what has been done in Italy.

According to Prince Conti, not far from Tatio, one of the extinct volcanoes of the Andes in Chile, near the Bolivian frontier, a syndicate of Italians and Chileans examined the local thermal resources and found them suitable for development. It is also reported that experiments in harnessing steam-wells have been in progress in Java.

The writers are preparing a report on the whole subject of the utilization of natural heat resources, and intend carrying out some experiments when opportunity permits. It is therefore proposed to here cover only very briefly and in a more general way certain interesting aspects which were not dealt with in the previous article in this *Journal*.

The Position in America.

The Rocky Mountains in the North and the Andes in the South, constituting the backbone of America, are of volcanic origin, and it is in the vicinity of these ranges that the most important volcanic manifestations of this Continent are to be found.

In the extreme north-west of Alaska is the imposing post-volcanic "Valley of Ten Thousand Smokes," resulting largely from the Katmai eruption in 1912. So powerful are some of the fumaroles in which the valley abounds that lead and even zinc can be melted in the steam issuing from the surface of the vent. Although this region is perhaps too remote to encourage any immediate agricultural and industrial development, the remarkable enterprise of the Icelanders in alleviating severe climatic conditions by harnessing natural heat for their homes and industries, and in the growing of horticultural crops, would indicate that this Alaskan area may offer considerable possibilities in the future.

The more important volcanic areas of the United States, such as Yellowstone Park and the Lassen Peak Thermal Springs, are not only comparatively inaccessible, but have been set aside as State reserves so that exploitation of the natural phenomena would be prohibited. It may be mentioned, however, that Yellowstone Park of Wyoming is an elevated plateau some 3,000 square miles in extent. While this area exhibits a variety of volcanic phenomena, it is celebrated for its geysers, which are located mainly in three basins within a radius of twenty miles near the centre of the park. Many of the thirty-nine active geysers shoot up boiling water to a height of from 100 ft. to 200 ft. The American view is that for size, power, and variety of action the geysers of this region have no competitors anywhere. The thermal area of Lassen Peak is confined to about eight localities occurring at intervals of a few miles. There are no geysers, and the whole region is apparently of a simple solfataric type duplicated in many parts of the world.

By far the most important developments in the investigation of post-volcanic phenomena in America are to be found in California. Since our previously published information we have found that the Sonoma natural power plant has been considerably improved, and now delivers 11,000 kilowatts to the neighbouring district. The problem of harnessing the steam in this district is relatively simple, as the unwanted gases are easily eliminated from the water vapour.

The following example serves to show that surprising thermal activity may sometimes be obtained artificially in apparently inactive areas. At Castiloga, situated on the same fault line as this Californian "Geyser Area," a considerable number of wells were sunk to obtain a water-supply. Instead of cold water, boiling hot water gushed out from each of the borings and rose to a height of about 200 ft., forming artificial geysers. All but one of these wells have been capped, and the hot water is now appropriately utilized for various purposes.

An interesting agricultural utilization is reported from a locality in the State of Nevada, where hot water from a quiescent geyser crater is piped to large dipping-baths employed for ridding the cattle of external parasites.

In the case of Chilean thermal areas, already referred to as being under investigation by a syndicate of Chileans and Italians in the vicinity of the extinct volcano Tatio, preliminary experiments indicated that at 270 ft. depth a considerable volume of steam particularly suitable for industrial application was available. A great quantity of natural steam also appears to be available in the volcanic area of Ollagua, in Bolivia. Here it is hoped to utilize the steam, which is said to exceed a capacity of over 100,000 kilowatts.

Natural Steam Power Developments at Larderello.

The natural steam power plant at Larderello, Tuscany, as was mentioned in the previous article, owes its origin to Prince Ginori Conti. The very satisfactory results of his preliminary experiments on a small scale since 1904 have led to the establishment of the large turbine power plant at Larderello, which has been in continuous use since 1916, distributing power for use at Leghorn, Siena, and Piombino, as well as supplying the various local works.

The steam supply for the Larderello station is obtained from some twelve wells, which together give 120,000 kg. of steam per hour at two atmospheres pressure. At first the steam was not led directly to the turbines, because the quantities of non-condensable gases in the steam would prove a hindrance to the condensing apparatus. It was therefore decided to heat with the natural steam appropriate evaporators for feeding the turbines, the water for these evaporators being obtained by condensing the natural steam. This system of intermediate evaporators and elaborate cooling-towers, though theoretically correct, did not prove entirely satisfactory in practice, as the corrosion of the evaporator tubes often caused a leakage of natural steam and accompanying gases into the turbine condenser, thereby reducing considerably the vacuum on which the turbine mainly depends for its output. The modern tendency has been to abolish all intermediate apparatus, especially the condenser plant. At Serrazzano, near Larderello, for example, entirely satisfactory results have been obtained with a 600 kilowatt turbine directly coupled to the natural steam. According to Conti, such power from the point of view of generating-expenses can be compared to hydro-electric power, with the advantage, however, that the plant is considerably cheaper, while it has all the advantages of ordinary steam minus the expense of fuel.

Boring for natural steam is evidently not a simple process, and unless a highly trained expert is employed disappointment is almost

certain. The technique used at Larderello consists in boring with the slow percussion drill, or, as is now more generally the case, large rotary drilling-machines are used. Iron tubes are set down to line the walls of the well as the drilling progresses. At a depth of about 100 ft. steam is usually found, and it is then that the major operation begins. The steam is diverted through a special head-piece attached to the well and bearing a horizontal tube, while the rods of the drilling-machine pass through an opening on the top of the head-piece. When the requisite depth has been reached the drilling-rods are withdrawn, and the steam either comes up spontaneously, or, as is more usually the case, the weight of water in the tube holds the steam. A rough piston is then inserted in the tube and rapidly extracted. If the operation has been successful, a miniature explosion takes place, and after several days the well settles down to its normal output and is ready for use.

According to *World Power*, 4th July, 1932, the Larderello power plant has recently been perfected, and at the present time the turbo alternators generate 12,500 horse-power.

Potentialities in New Zealand.

The possibilities of natural heat utilization in New Zealand were touched upon in the previous article. As a result of observations made by one of the writers during a recent visit to Rotorua, it is thought that the thermal area there, while far more extensive and perhaps more powerful, is not intrinsically different from the Larderello area. If small-scale experiments were organized on a rational basis and a survey made of our thermal regions, it is possible that large-scale power plants would ultimately be practicable, as at Larderello.

The abundance of hot and boiling pools in and around the town of Rotorua would lead one to suppose that the hot water will one day be satisfactorily tapped and utilized by means of a suitable system of pipes for the forcing of glasshouse crops in addition to heating homes, offices, &c.

Chemical tests of typical warm soil collected from near some of the innumerable warm pools at Rorotua indicate that the acidity of the earth in certain cases is much too great for the production of crops, and before satisfactory agricultural utilization is possible it would be necessary to convey the warm water underground to less acid areas with the aid of series of non-corrodable pipes. In this connection it is interesting to note that in the case of a large pipe-line leading from a large area of boiling water near the Spout Baths for a distance of nearly two miles to the Ward Baths the temperature drop is 50° C.

A recently published statement by Prince Conti regarding the possibilities of natural-heat utilization in New Zealand may be quoted as follows: "I consider that the New Zealand steam springs are quite worthy of being carefully studied and compared with those of Tuscany, and I do not doubt that competent authorities will take the matter up and devote the necessary care and study to the investigation of these phenomena, the importance of which must not be too lightly and hastily considered."

In a later article it is proposed to reproduce some illustrations of natural steam power plants and other methods of utilization in Italy and elsewhere.

HOT-WATER TREATMENT OF SEED BARLEY.

CROP RESULTS IN CANTERBURY, SEASONS 1930 TO 1933.

C. H. HEWLETT and J. H. HEWLETT, M.A., Canterbury (N.Z.) Seed Company, Ltd., Christchurch.

SINCE the last report on this work, conducted by the Canterbury Seed Co., with the advice and assistance of Mr. J. C. Neill, Field Mycologist, Department of Agriculture (see *Journal* for August, 1932), another year's results have become available and should be of advantage to barley-growers.

The loss to the farmer through following the old method of using his own seed was pointed out last year. In spite of this, some growers continue to use infected seed, instead of sowing a pure strain of smut-free seed. The results of this year's work further confirm the loss to the barley-grower by such practice, Tables 1 and 2 showing to what a serious extent the quality of the product was thereby adversely affected. The tables refer to the Canterbury barley crop of 1933, and afford a comparison between the quality of the product of treated seed and of growers' own seed.

Table 1.—Grading of Product of Treated Seed, Year 1933. (Average of all Districts.)

(In all the tables mill firsts only are dealt with.)

Quality.	Chevallier.	Spratt-Archer.	Goldthorpe-Spratt.	Plumage-Archer.	Total.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
No. 1 Grade ..	55·0	27·7	13·6	34·0	38·9
No. 2 Grade ..	17·0	22·1	27·2	30·4	23·2
Under grade ..	28·0	50·2	59·2	35·6	37·9
Total ..	100·0	100·0	100·0	100·0	100·0
Number of farms ..	72	59	7	41	179
Acres	671	544	90	605	1,910

Table 2.—Grading of Product of Grower's Own Seed, Year 1933. (Average of all Districts.)

Quality.	Chevallier.	Spratt-Archer.	Goldthorpe-Spratt.	Plumage-Archer.	Total.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
No. 1 Grade ..	29·0	3·7	100·0	..	26·6
No. 2 Grade ..	34·2	32·5	..	..	28·5
Under grade ..	36·8	63·8	..	..	44·9
Total ..	100·0	100·0	100·0	..	100·0
Number of farms ..	9	16	1	..	26
Acres	103	212	24	..	339

The general average yield from owner's seed was 5·2 bushels per acre less than the average from treated seed. Assessed in cash, the total loss on yield plus grade to the twenty-six farmers who grew their own seed was 17s. 8d. per acre. The figures have been compiled from mill firsts only, but if the mill seconds were to be included in both the treated and owner's seed, the loss to the twenty-six farmers who grew their own seed would be increased to £1 1s. 9d. per acre.

A period covering the last four years is reviewed in Tables 3 to 12. The object of these figures is to supply the grower with information regarding the barley crop in his own district in the hope that it may be of some assistance to him. The tables present a condensed summary of the actual harvest results, and in considering the data greater notice should be taken of averages covering a period of years than those covering one year only.

ELLESMERE DISTRICT.

Table 3.—Yields per Acre.

Year.	Number of Farms.	Acres.	Chevallier.	Spratt-Archer.	Goldthorpe-Spratt.	Plumage-Archer.	Total.
			Bushels.	Bushels.	Bushels.	Bushels.	Bushels.
1930 ..	159	3,088	49·04	52·83	25·40	41·15	51·96
1931 ..	221	4,489	34·94	41·32	49·72	69·86	40·33
1932 ..	134	2,003	33·67	38·22	49·28	51·93	38·11
1933 ..	153	1,721	41·70	38·60	46·90	45·80	42·0
Total ..	667	11,301	38·8	44·3	45·6	47·7	43·4
Number of farms ..	..	..	152	461	7	47	667
Acres ..	..	..	2,389	8,061	140	711	11,301

Table 4.—Grading of Product (No. 1 Grade).

Year.	Number of Farms.	Acres.	Chevallier.	Spratt-Archer.	Goldthorpe-Spratt.	Plumage-Archer.	Total.
			Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1930 ..	159	3,088	95·03	79·00	100·00	100·00	81·45
1931 ..	221	4,489	39·42	49·64	100·00	100·00	48·91
1932 ..	134	2,003	45·83	52·71	100·00	83·38	54·78
1933 ..	153	1,721	47·6	24·4	Nil*	28·9	32·1
Total ..	677	11,301	55·5	59·7	47·1	49·4	58·0
Number of farms ..	..	..	152	461	7	47	667
Acres ..	..	..	2,389	8,061	140	711	11,301

* None passed as No. 1 Grade.

DUNSANDEL DISTRICT.

Table 5.—Yields per Acre.

Year.	Number of Farms.	Acres.	Chevallier.	Spratt-Archer.	Goldthorpe-Spratt.	Plumage-Archer	Total.
			Bushels.	Bushels.	Bushels.	Bushels.	Bushels.
1930 ..	15	368	51·69	53·50	45·83	..	52·65
1931 ..	22	469	40·26	35·75	28·16	..	35·78
1932 ..	6	116	..	24·28	..	..	24·28
1933 ..	8	122	45·5	23·8	..	54·4	39·4
Total ..	51	1,075	44·8	39·8	38·5	54·4	40·7
Number of farms	..	..	9	37	3	2	51
Acres ..	..	..	112	869	60	34	1,075

Table 6.—Grading of Product (No. 1 Grade).

Year.	Number of Farms.	Acres.	Chevallier.	Spratt-Archer.	Goldthorpe-Spratt.	Plumage-Archer.	Total.
			Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1930 ..	15	368	100·00	80·66	100·00	..	83·61
1931 ..	22	469	87·04	26·57	Nil*	..	32·13
1932 ..	6	116	..	46·02	..	..	46·02
1933 ..	8	122	69·2	Nil*	..	100·0	64·6
Total ..	51	1,075	84·1	52·9	69·5	100·0	59·4
Number of farms	..	..	9	37	3	2	51
Acres ..	..	..	112	869	60	34	1,075

* None passed as No. 1 Grade.

LINCOLN DISTRICT.

Table 7.—Yields per Acre.

Year.	Number of Farms.	Acres.	Chevallier.	Spratt-Archer.	Goldthorpe-Spratt.	Plumage-Archer.	Total.
			Bushels.	Bushels.	Bushels.	Bushels.	Bushels.
1930 ..	48	571	53·77	53·08	36·63	34·42	50·60
1931 ..	52	771	52·65	42·03	33·38	51·62	44·97
1932 ..	42	365	46·45	35·56	32·63	..	39·14
1933 ..	42	361	53·5	37·4	62·6	49·2	49·3
Total ..	184	2,068	52·0	43·5	39·5	45·8	46·3
Number of farms	..	..	78	76	23	7	184
Acres ..	..	..	738	997	221	112	2,068

Table 8.—Grading of Product (No. 1 Grade).

Year.	Number of Farms.	Acres.	Chevallier.	Spratt-Archer.	Goldthorpe-Spratt.	Plumage-Archer.	Total.
			Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1930 ..	48	571	81·98	71·10	100·00	100·00	78·45
1931 ..	52	771	91·21	61·95	62·19	Nil*	67·99
1932 ..	42	365	70·52	5·00	46·74	..	40·29
1933 ..	42	361	57·9	15·9	92·5	52·3	52·9
Total ..	184	2,068	77·0	53·1	76·7	40·7	64·2
Number of farms ..	..	..	78	76	23	7	184
Acres ..	..	..	738	997	221	112	2,068

* None passed as No. 1 Grade.

NORTH CANTERBURY.

Table 9.—Yields per Acre.

Year.	Number of Farms.	Acres.	Chevallier.	Spratt-Archer.	Goldthorpe-Spratt.	Plumage-Archer.	Total.
			Bushels.	Bushels.	Bushels.	Bushels.	Bushels.
1930 ..	5	128	..	41·50	..	57·36	52·41
1931 ..	8	182	..	35·00	..	49·95	45·35
1932 ..	4	123	27·00	15·00	..	48·93	28·82
1933 ..	2	45	..	..	..	27·0	27·0
Total ..	19	478	27·00	30·6	..	49·6	42·4
Number of farms ..	..	..	1	6	..	12	19
Acres ..	..	..	20	156	..	302	478

Table 10.—Grading of Product (No. 1 Grade).

Year.	Number of Farms.	Acres.	Chevallier.	Spratt-Archer.	Goldthorpe-Spratt.	Plumage-Archer.	Total.
			Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1930 ..	5	128	..	Nil*	..	46·35	34·88
1931 ..	8	182	..	64·29	..	27·14	35·96
1932 ..	4	123	Nil*	Nil*	..	Nil*	Nil*
1933 ..	2	45	..	..	..	Nil*	Nil*
Total ..	19	478	Nil*	26·4	..	27·0	26·2
Number of farms ..	..	..	1	6	..	12	19
Acres ..	..	..	20	156	..	302	478

* None passed as No. 1 Grade.

SUMMARY OF DISTRICTS, 1930, 1931, 1932, 1933.

Table 11.—Yields per Acre.

District.	Number of Farms.	Acres.	Chevallier.	Spratt-Archer.	Goldthorpe-Spratt.	Plumage-Archer.	Total.
			Bushels.	Bushels.	Bushels.	Bushels.	Bushels.
Ellesmere ..	667	11,301	38·8	44·3	45·6	47·7	43·4
Dunsandel ..	51	1,075	44·8	39·8	38·5	54·4	40·7
Lincoln ..	184	2,068	52·0	43·5	39·5	45·8	46·3
North Canterbury	19	478	27·0	30·6	..	49·6	42·4
Total ..	921	14,922	41·9	43·6	41·4	47·9	43·5
Number of farms	..	..	240	580	33	68	921
Acres ..	..	..	3,259	10,083	421	1,159	14,922

Table 12.—Grading of Product (No. 1 Grade).

District.	Number of Farms.	Acres.	Chevallier.	Spratt-Archer.	Goldthorpe-Spratt.	Plumage-Archer.	Total.
			Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Ellesmere ..	667	11,301	55·5	59·7	47·1	49·4	58·00
Dunsandel ..	51	1,075	84·1	52·9	69·5	100·0	59·4
Lincoln ..	184	2,068	77·0	53·1	76·7	40·7	64·2
North Canterbury	19	478	Nil*	26·4	..	27·0	26·2
Total ..	921	14,922	62·4	58·2	64·9	44·6	58·1
Number of farms	..	..	240	580	33	68	921
Acres ..	..	..	3,259	10,083	421	1,159	14,922

* None passed as No. 1 Grade.

Incidence of Disease.

Very heavy rain fell immediately after sowing, followed by six weeks of warm, humid weather; thereafter conditions were extremely dry. Following are summarized observations regarding the various fungus diseases:—

Loose smut: None observed. *Covered smut:* None observed in crops from direct hot-water treatment and once and twice removed from direct treatment crops grown from seed supplied by the Company. A trace present in some of the crops grown from grower's own seed. *Rust:* Severe and early incidence, especially on the heavier land. *Mildew:* Moderate to light in early stages of growth only. *Stripe:* A trace only in a few crops.

Ensilage without Weighting.—An ensilage trench, near Whangarei, upon which no covering of earth was used—only a cover of corrugated iron being placed to overlap the whole trench—when opened showed about 1 ft. depth of wastage on top, but otherwise excellent silage and with no wastage at the sides.

NOTES ON RECENTLY OBSERVED EXOTIC WEEDS.

(3) The Genus Sisymbrium.

H. H. Allan, Botanist, Plant Research Station, Palmerston North.

The cruciferous genus *Sisymbrium* contains some eighty species, mostly of a weedy nature, and is mainly of European and Asiatic origin. Many species are now widely spread as weeds. One, the hedge mustard, has been known in New Zealand for many years and now occurs throughout the country; another, flixweed, is confined to a small area in Central Otago. The others mentioned here have not before been recorded, but some of them must have been in the country for a long time. Apart from the mischief they create as weeds, they are liable to cause trouble by harbouring insect pests, and by becoming the host of disease-forming fungi and bacteria.

In these days of the "white butterfly" it becomes important to find out what cruciferous weeds act as feeding-grounds; the butterfly has been noted on a number, but we do not know at present how far they really serve as food for the larvæ. On all counts "clean" farming should include an effort to keep cruciferous weeds at a minimum. And in the fight against weeds, it has been well said, an essential preliminary is to know with some exactness what the species actually are. As there has been some confusion as to what species of *Sisymbrium* occur in New Zealand, it seems well to give descriptions of them all. By the aid of the key, and of the drawings from the pen of Mr. V. D. Zotov, Assistant Botanist to this Station, it should be possible for any one to identify the specimens observed.

Key to the Species.

1.	Leaves doubly and finely dissected, "carrot like" ..	*S. Sophia.*
	Leaves with coarser segments, or merely toothed ..	2
2.	Pods conical, appressed to stem	*S. officinale.*
	Pods narrow, linear, spreading	3
3.	Pods clustered in axils of leaves	*S. polyceratium.*
	Pods on long naked stems, terminating the plant ..	4
4.	Pod stalks very slender and rather soft	*S. irio.*
	Pod stalks as stout as the pods, harder	5
5.	Plant usually without hairs, upper leaves finely cut	*S. altissimum.*
	Plant usually hairy, upper leaves not cut into fine segments	*S. orientale.*

S. irio (Fig. 3), London rocket: This reaches a height of 2 ft. The lower leaves are lobed, the lobes rather broad and cut almost to the mid-rib. The slender pods, about 1½ in. long, are on very fine stalks, distinctly narrower than the pods themselves, and stand rather erect on the stems. Apparently this species is rare—I have a specimen from an Auckland garden—but it is one that would spread rapidly if given a chance.

S. altissimum (Fig. 2), tumbling mustard: A spreading plant, up to 4 ft., with numerous slender branches. The basal leaves are rather like those of the dandelion in shape, but soon disappear. They are succeeded by ever more finely cut leaves, till the upper ones are reduced to skeleton-like narrow linear segments. The flowers are a

PODS AND LEAVES OF SISYMBRIUM SPECIES.

(1) Oriental mustard, (2) tumbling mustard, (3) London rocket, (4) cluster mustard, (5) flixweed, (6) hedge mustard.

pale yellow, the pods stiff, hardly thicker than their stalks (a contrast to those of *S. irio*), about 2 in. to 3 in. long. When mature the stems break away and may be distributed long distances, shedding seeds as they go. The seed production is exceptionally plentiful, even for this genus. This species has been noted in Auckland gardens, where it appears to be plentiful, in the neighbourhood of Wanganui, in waste places near Wellington, and has recently been sent in from Alexandra, in Central Otago. I noted a large patch near a rabbiter's camp at the base of Mount Ruapehu, where horses had been fed.

S. orientale (Fig. 1), oriental mustard: This is closely related to and of rather similar habit to the previous species. It is usually,

however, more or less clothed in roughish hairs. The leaves have fewer and broader segments, the lower segments extending downward like tails. The upper leaves are not skeleton-like as in *S. altissimum*, while the flowers are a brighter yellow. It has so far been observed in the neighbourhood of Auckland, Thames, and Palmerston North. At Auckland both the hairy and the smooth (var. *leiocarpum*) forms have been met with.

S. polyceratium (Fig. 4), cluster mustard: This rather low-growing species differs markedly from the others in the arrangement of the pods. The stems are very leafy, coarsely toothed. The pods are rather stout, somewhat curved, about 1 in. long, and arranged in clusters, usually of three, in the axils of the leaves. This plant comes from the Mediterranean regions. I noticed it in 1929 as a fairly common roadside weed at Alexandra, Central Otago. So far it has not been met with elsewhere.

S. Sophia (Fig. 5), flixweed: This is easily distinguished by the doubly and finely cut leaves (many have still narrower segments than in the one illustrated). The pods are about 1¼ in. long, somewhat curved, on rather long stalks. This has been present, sparingly, near Alexandra and Naseby for many years. Though it seeds profusely, it has not extended its area, and does not appear to cause any trouble as a weed.

S. officinale (Fig. 6), hedge mustard: In fruit this is at once known by the narrowly conical, more or less hairy pods, about ½ in. long, closely appressed to the branching stems. It may reach 3 ft. in height. The large, coarse, basal leaves are broadly lobed, the end segment being much the larger. At maturity the plant may be almost leafless, with stiff purplish stems and pods. It was recorded as early as 1864 as a plant of waste land. It is now spread throughout the country, chiefly as a weed of waste ground, roadsides, and hedges. It is much subject to club-root disease, and may serve as a source of infection to cruciferous root crops.

EXPERIMENTS WITH VARIOUS GRITS FOR FOWLS.

H. A. Kitto, Overseer, Wallaceville Poultry Station.

In the March, 1931, issue of the *Journal* were published the results of an experiment conducted at Wallaceville Poultry Station for the purpose of ascertaining which of the two kinds of shell—old cockle or fresh oyster shell—would be the more palatable to fowls, and also to determine their respective values for egg-shell formation. During the past year a further experiment was carried out at the Station covering a period of twenty-three weeks, from 5th July to 13th December, 1932. In this experiment four different kinds of sea-shell and two of limestone were used—namely, fresh oyster shell, fresh toheroa shell, old cockle shell, and old pipi shell. One kind of limestone used came from Auckland Province and the other from Otago.

As in the previous test, the object aimed at was to ascertain as far as possible the kind of material that would be most palatable to the birds and most suitable for the manufacture of egg-shells. An even line of two hundred and forty White Leghorn pullets of the same age and strain were used in the test, and were equally divided into six houses. One kind of grit only was made available to the birds in each house, an equal weight being put into boxes 15 in. square and 4 in. high, and left before the birds at all times to pick at, additional quantities being provided as required.

The following table shows the total weight of each kind of grit consumed by the birds in the respective houses :—

Table 1.

House No.	Kind of Grit.	Weight consumed.
		lb.
1	Fresh oyster shell	94
2	Old cockle shell	81½
3	Otago limestone	59
4	Old pipi shell	83½
5	Auckland limestone	107½
6	Fresh toheroa shell	95¾

Oyster shell in proportion to its weight was much greater in bulk than the other materials used, of which there was little difference, both as regards weight and measure.

As regards egg-shell quality, the nests were frequently visited throughout the day during the period of the test for the purpose of detecting any soft- or thin-shelled eggs produced. It is safe to assume, however, that a certain number of eggs with no shells and some with shells of poor quality were not observed. Taking the shell quality of all eggs produced those from birds in Houses 1 and 6 were the best regarding thickness, texture, and bloom in shell, while from this standpoint the shells of eggs produced from birds in Houses 4 and 5 could generally be regarded as good average quality. The shell material of eggs laid in Houses 2 and 3 could not be considered as decidedly inferior quality, but they were generally weaker in shell than the others referred to.

In regard to unmarketable shell-less eggs and those which could not be packed in an ordinary egg-crate owing to thinness of shell, Table 2 shows the number of these produced in each house :—

Table 2.

House No.	Kind of Grit.	Number of Shell-less Eggs.	Number of Thin-shelled Eggs.
1	Fresh oyster shell	..	1
2	Old cockle shell	4	4
3	Otago limestone	4	3
4	Old pipi shell	..	3
5	Auckland limestone	2	..
6	Fresh toheroa shell	..	1

TREE PLANTING ON THE FARM.

Paper read by Mr. C. H. WILLIAMS, Muriwai, Gisborne, at Annual Meeting of Sheep-farmers, Massey Agricultural College, May, 1933.

IN the time at my command it is obviously impossible to do more than touch the fringe of a very big subject, or to deal with more than a few better-known varieties of trees. I have thought it advisable also to confine myself to trees of which I have actual personal experience. There will be numbers of equally valuable varieties within the personal experience of others which either do not thrive in my immediate neighbourhood, or which I have never as yet tested.

Tree planting on the farm serves three main purposes: (1) The beautifying of the home, of its surroundings, and of the district; (2) the provision of shade and shelter for the live-stock; (3) the provision of farm timber supplies.

Of the first purpose not much need be said. Fortunately for the Dominion its people have what may be termed the "tree and garden sense," and a home devoid of attractive gardens or plantations is a comparative rarity. The choice of suitable species for this purpose is a matter of individual taste, and the greater the freedom from convention the better will be the effect.

SHELTER TREES.

Shade and shelter for stock are almost as necessary for successful farming as food and water, while protection in the form of hedges or plantations against the parching effect of high winds undoubtedly increases the carrying-capacity of the land, besides modifying variations in temperature. The direct sheltering effect of a belt of trees extends to ten times the height of the trees; the indirect or partial effect a great deal further.

The trees most in favour in New Zealand for shelter belts are the pines, the cypresses, the eucalypts, and the acacias. Of the pines the commonest is the radiata or insignis, and I think in most localities it is the most useful. It is easy to establish, very rapid in its growth, and its timber is valuable. But it has a habit of thinning out at the base, and the wind whistles through an old plantation at ground-level very much as if the trees were not there. An insignis break-wind is not complete without a row or two of Cupressus Lawsoniana or some such dense-growing tree to provide against this. Cupressus macrocarpa makes a splendid break-wind, but has the same defect (though to a lesser degree) and needs supplementing in the same way.

Cupressus Lawsoniana by itself is most efficient, but it is a slow grower and you have to wait for results. On suitable land a fine break-wind can be made of Lawsoniana, backed by Lombardy poplars. Large cuttings of the latter can be put in 8 ft. or 10 ft. apart, and give protection very quickly. When the Lawsoniana attain some height the whole forms a perfect wind shelter and occupies a minimum of space. Poplar cuttings should be planted with at least one-third of their length in the ground, or the shoots will not appear strongly at the top. If good solid cuttings are used, reaching above the possibility of damage by stock (say, 6 ft. 6 in. or 7 ft.), posts and space can be saved by building the protecting fence along the line of cuttings. A stout

batten nailed to the tree serves as a ground on which to staple the wires. Horses should be kept away from poplars until the cuttings attain some size. They are keenly fond both of the young shoots and the bark.

The eucalypts are quite excellent for wind breaks and have the advantage of renewing themselves when cut. Indeed, for this purpose, they need periodical cutting in order to maintain density. The varieties of this family will be discussed later in dealing with the timber question.

The acacias give very rapid results, are easily established from seed sown *in situ*, make excellent firewood, and if cut at the right time will renew themselves (cutting in the winter may kill black wattle, for instance). The most common varieties are Acacia decurrens (black wattle), A. dealbata (silver wattle), and A. normalis. The last is very ornamental, but is rather too brittle. These three varieties rapidly become tall, and thin out at the base, and will need cutting to produce density, but there are a number of smaller, slower-growing varieties very suitable for the purpose. A serious drawback to the acacia is the liability to blight, a kind of brown canker or gall which appears on twigs and branches. I have noticed this very frequently on black wattle, but not as yet on other varieties.

In planting break-winds in the paddocks it must be remembered that a belt of tall forest trees running east and west will destroy the feeding value of quite a large strip of ground on the shady side. For this reason it is better to use the lower-growing cypresses for warding off the southerly winds and the taller growing pines or eucalypts for breaking the westerlies. Hedges, of course, are invaluable in the former case, but I have had little experience with them and, therefore, refrain from making suggestions.

For shade purposes the willow is the easiest tree to establish and gives the quickest results, but I am far from sure that it is the best in the long-run. The weeping willow is a greedy tree, and, besides, in very windy localities it is likely to become broken or uprooted. I have seen very nice shade provided by planes and also by the spreading varieties of poplar. The feeding-value of the weeping willow, in case of a dry summer, is, of course, a great point in its favour.

A tree of special merit, either for shade or shelter, is the marcocarpa. The side branches of this tree leave the trunk at an acute angle and, consequently, rain water is gathered to the centre of the tree and runs down the trunk. Sheep will keep almost as dry under a macrocarpa plantation, during ordinary showery weather, as in a shed; while in a heavy storm newly shorn sheep are absolutely safe. Half an acre of well-grown macrocarpa plantation near a wool-shed, with a hay-stack adjacent, is a first-rate insurance against loss by exposure.

Another method of using macrocarpa is as shelter for lambing stud ewes. Four of five rows of any length are planted very precisely, and 6 ft. apart, across the line of the dangerous wind. The back row is permanent, but only every third or fourth tree of the other rows is permanent, and the remainder are cut out to allow these to spread out. In a few years corrugated iron can be nailed along the back row at ground-level, and rails or corrugated iron built out at right angles on the trees left for the purpose, and you are provided with a series of well sheltered pens at a minimum cost.

While on the subject of lambing-ewes I might mention a device which has saved me much trouble on clean flat paddocks. I get a

few dray loads of sturdy, vigorous rush plants with substantial butts. These are placed in little rows or semicircles of eight or ten. They stand firm on their butts and very few are blown over. If they are spaced all over the paddock you will find lambs in dozens taking advantage of the shelter. If a lamb is born into rough weather a couple of these rushes can be dragged over to it is as many minutes, and the ewe is hardly disturbed. When lambing is over the rushes are carted off and burnt.

A point to be remembered in all shade or shelter planting is the effect of the cast leaf material or seed-cases upon the sheep's wool. Most people will know the mess that is made of a fleece by the debris of the native white-pine, for instance. I do not think any of the trees I have mentioned are offenders in this respect, though it is, of course, necessary to clear the boles of protruding branches for a few feet up from the ground.

Farm Timber Supplies.

The main timber requirements on the farm are firewood, fence posts and battens, gate or strainer posts, and gate timber.

FIREWOOD.

For firewood the following species may be considered: The pines, the eucalypts, and the acacias.

You wait quite a long time for your firewood from Pinus insignis, but you get an enormous crop. The trees, if grown thickly, are fairly easily split and the wood is good. There are two objections, neither very serious. First, when you cut a tree it is gone and you have to replace it; second, the smoke of insignis forms a quantity of rather inflammable soot, which means that chimneys must be swept regularly. There are many other pines that make splendid firewood, but none give such a rapid and copious return as insignis. There is a pine—I think it is Coulteri—that is worth growing for its cones, which are as big as a football, and make a beautiful fire in an open fireplace.

The eucalypts are excellent, and most of the varieties that will be mentioned as useful timber are also good firewood. Again you have to wait fourteen or fifteen years for a crop, but it is a good crop of very good firewood, and when it is cut it grows again and you get another crop in five or six years. As far as I know, you can go on cutting almost indefinitely. When cutting eucalypts the trunks should be sawn off about level with the ground, so that new growths will get support, otherwise there is the nuisance of their splitting off in a high wind.

The silver wattle and the black wattle give earlier returns than either pines or eucalypts, and the firewood, especially the black wattle, is probably the best and most easily worked that can be grown. The silver wattle suckers very freely, even before it is cut, and, though this habit is a great advantage in a firewood plantation, it should not be planted where suckering will become a nuisance. Black wattle cut in summer will renew itself very effectively. Wattle is difficult to transplant, and the plantation should be established by drilling the seed in rows and thinning later. The possibility of losing the plantation through blight is the only objection I know to the wattle.

The Robinia pseudo-acacia or thorny acacia will be discussed with the fence post timbers, but it is also a particularly good firewood when

dry. It renews itself freely by suckering and in the wrong position can be a nuisance. Stock are fond of the young shoots and prevent it spreading in the paddocks.

Macrocarpa as firewood has a habit of throwing out sparks almost as badly as totara. It is good fuel and quite safe in a stove or range, but in an open fireplace needs watching.

The best provision, I think, that can be made for a permanent supply of firewood on a farm is a few acres of eucalypts or of wattles, or, better still, of both.

FENCE POSTS.

Which are the best varieties of trees to plant for fence posts is probably the most important question for the farmer, for every one of us needs them in plenty, and they are a source of heavy expense.

Undoubtedly eucalypts should be planted, but you will have to wait for the crop. Your son will probably reap it. The suitable varieties whose durability without preservative treatment may be said to be proved in New Zealand are few. I can only mention three—Eucalyptus Macarthuri, E. eugenioides, and E. Muelleriana. Of these three the first is by far the most rapid in growth, it is very easy to establish by bare root transplanting, and it splits fairly well. Posts split from a fairly mature tree—say, forty-five or fifty years old—are proved to be reasonably durable, but I cannot answer for timber from younger trees. Eugenioides and Muelleriana are more difficult to establish, and the latter will not endure very severe frosts. They should be transplanted from trays as seedlings, and should, if possible, be cultivated for the first season, after which they will take care of themselves.

Three other varieties that have been recommended are E. viminalis, E. botryoides, and E. saligna. Viminalis transplants like a weed and grows quickly, but even from a forty-five-year-old tree the life of the timber in contact with the ground is very limited. Botryoides on suitable ground grows very rapidly and when mature it may be durable, but I have seen posts split from a young tree quite rotten in seven years. Saligna is a beautiful tree, growing a nice clean bole ; it is a less rapid grower than the other two, but, as far as I know, its durability has not been tested in New Zealand. Like botryoides, the immature timber rots very quickly.

It is probable that many eucalypts are durable when well matured, but we cannot afford to wait fifty years for our posts. I am sure that durability in all cases could be vastly increased by the use of preservatives, but without some such treatment the only trees I know that will furnish durable posts in less than twenty years are the macrocarpa and the thorny acacia. But the former will not renew itself, and it hardly pays to cut a whole tree for one or two fence posts and then have to plant another. You want your macrocarpa to grow into strainer posts or trees of a splitable size. There remains only thorny acacia, and I am sure that on any country that will grow this tree healthy and straight it will pay handsomely to provide patches of it in convenient places. The heart wood is extremely durable, even at twelve or fourteen years old, and with a diameter of only 5 in. or 6 in. A defect in the timber is that it is inclined to crack and drop the staples. This can be partly overcome by taking a slice off one side with a circular saw and getting clean heart wood to staple into. Another objection is the difficulty of working owing to thorns.

For gate or strainer posts macrocarpa and thorny acacia will give the earliest possible return. I have cut macrocarpa posts for a cattle-yard, 10 ft. long and with a minimum of 8 in. of heart wood, from a plantation only eighteen years old, getting two such posts from many trees, and in one case two 10 ft. posts, one 8 ft. gate post, and a 6 ft. 6 in. fence post from one tree—nearly 35 ft. of effective bole.

RAILS, BATTENS, AND GATE TIMBER.

For rails or battens it is as well to put in plenty of the more durable eucalypts, but there are several varieties much more rapid in their growth than the three mentioned for posts, and quite good when not in contact with the ground, or for sawing into gate timber.

Among the rapid growers that are easily split are E. regnans, gigantea, fastigata, obliqua, viminalis, botryoides, and saligna. The first of these is, I think, the most rapid. I cut a regnans quite recently twenty-four years old, with a diameter of nearly 36 in. at the butt. Most of the tree was split into battens, but one 16 ft. log was sawn into gate timber, producing over 400 superficial feet. Another tree of the same age, cut a week or two ago, gave a clean log 48 ft. long, 30 in. in diameter at the butt, and tapering to 20 in.; it produced 1,056 superficial feet, besides two cords of firewood and some split rails. Obliqua is a most useful and ornamental eucalypt, being fairly rapid in growth and a particularly good splitter. It is, I believe, known in Australia as the messmate gum, and furnishes much of the V.D.L.* hardwood imported into New Zealand. It is difficult to transplant, but grows readily from seed sown *in situ*. I have seen a good stand of obliqua established by sowing seed broadcast on a piece of land on which manuka had been cut and burnt. Fresh young manuka plants furnished shelter for the seedlings, which grew vigorously and well.

Any of the varieties mentioned should furnish saw logs for gate timber within a reasonable time—say, twenty to thirty years. At such an early period as this, however, it is very difficult to saw eucalypt logs into straight even boards. When the log is cut into, the pull of the sap wood will draw the cut portion into a bow shape and the resulting boards cannot be straightened. I am told that this can be partly obviated by squaring the log before it is cut into, but even with this precaution a certain amount of distortion occurs. It is essential to stack the timber as soon as possible; it should be carefully filleted in an airy position protected from the rays of the sun.

A great objection to many of the eucalypts for fence battens is the difficulty of stapling into them when thoroughly seasoned or used a second time, but this could be overcome by using a special staple, such as is on the market for use with the imported hardwood battens. Another objection is their weight. They have to be split fairly big on account of their liability to crack with the staples, and their transport about the farm is therefore costly.

It will be understood that in discussing a family so numerous and varied as the eucalypts it is out of the question to mention more than a few. There may be many others quite as valuable as those I have named, but they are outside my own experience. For full information regarding the eucalypts I would refer you to the book by Rev. J. H. Simmonds, of Takanini, Auckland.

* A trade abbreviation for Van Diemen's Land.

Other Useful Trees.

Some other varieties of trees deserve mention as suitable for farm planting or for special purposes. With a little foresight a cattle-yard can be provided with live Lombardy poplars as posts. Though the full-grown trees would be too bulky for the internal divisions, the whole of the outside fence could be built on growing poplars. With good sturdy cuttings the trees should be ready to carry railing in a few years.

A drain can be kept clear of obstructing vegetation by a row of eucalypts along each bank. When it is first dug it is easy to plant along the spoil, and in a very few years the whole drain is densely shaded. The eucalypt roots do not encroach and the refuse dropped by the trees is negligible. On the Rangitaiki Swamp the cleaning of drains is an annual necessity and a heavy expense, but when they have been treated in this way they can remain untouched almost indefinitely. E. Macarthuri is especially suitable for this purpose.

Another special purpose tree is Cryptomeria Japonica, the timber tree of Japan. This tree is able to thrive under dense shade, and is therefore invaluable for filling gaps in plantations or for thickening up a patch of native bush.

The Sequoia sempervirens or redwood is worth a place on the farm, but you plant redwood for your son or grandson. This tree, when cut, will renew itself vigorously from the cut crown. But do not plant redwood for firewood, for it simply will not burn. For sawmilling this timber has, of course, great value, but it must attain reasonable maturity. Timber from trees under thirty years old, cut at Rotorua, proved much inferior to the imported redwood, but some trees about seventy years of age in Auckland produced timber within about 20 per cent. of the strength of the Californian article. Both redwood and Cryptomeria Japonica can be transplanted with the greatest ease.

The value of willows for checking slips or preventing erosion is well known to everybody, but I might mention a method of planting which is of advantage in establishing them, especially in a creek-bed. The cuttings are set in groups, one or two on each side of the watercourse, drawn together tripod fashion a foot or so from the top, and tied firmly with tarred twine or wire. They are then firm enough to stand pressure from wind or stock, while the new shoots also have a certain measure of protection. Willow or poplar cuttings should be planted one-third of their length in the ground to get good results.

A plantation of English oak is perhaps the easiest and cheapest of any to establish. It grows quickly in this country and has the merit of possessing great beauty. Besides furnishing a prospective crop of very valuable timber, its fall of acorns is not to be despised for pig fodder. Pigs running in an oak plantation pick up every acorn and do splendidly on them.

The walnut is a beautiful tree and gives plenty of shade, while the annual crop of nuts pays very well for the gathering. A few additional shillings in the farm income these times are very welcome.

I think other valuable trees could be found among the cypresses. Cupressus sempervirens, for example, known, I believe, as the Roman cypress, will grow a beautiful straight pole in twenty years, and in thirty years should be of ideal size and shape for a power pole. If it is as durable as C. macrocarpa it would be a most suitable tree to plant for that purpose.

The Well-planted Farm.

To sum up, and without going outside the bounds of strict utility, I will give my idea of the well-planted farm or sheep-run. At the homestead there will be some acres of acacia and of eucalypts for fuel purposes. There will be an acre or two of thorny acacia, of the more durable eucalypts, and of the rapid-growing ecualypts for timber purposes, while wind-breaks of pines or cypresses will also contribute to the future timber-supply. At the wool-shed will be a good patch or two of macrocarpa to supplement the shed accommodation and to provide for the safety of newly shorn sheep in rough weather. Out on the farm each paddock will have its shelter belts and its shade trees. In suitable positions over the run there will be plantations for the supply of fence posts; while at each set of yards a sufficient area will be set aside for growing the replacements that will surely be required before many years have elapsed; thorny acacia, marcocarpa, and some rapid-growing eucalypts for posts and rails in the near future and some of the more durable hardwoods to take up the running later.

To the younger men it may seem a long time to wait for results, but to the older men, looking backward, twenty or twenty-five years is a very brief period, and I venture to say that there are many present who regret that they did not plant earlier and more freely, and who kick themselves every time they sign a cheque for fence posts, battens, or firewood supplied.

Advice to intending Planters.

I would like to add a few words of advice to intending planters. First: Make a point of keeping a permanent record of all plantations—varieties of trees and dates of planting. The existence of timber trees on a farm is an asset which gains in value every year. It is a great advantage to know definitely the age and value of all your trees. Second: Give the position of plantations plenty of consideration, remembering that downhill haulage is cheaper than uphill; that some varieties of trees prefer southerly faces and some northerly; that trees in a gully or pocket will be drawn up more rapidly than on a hill.

Climate and soil conditions must be reckoned with. There is in the Eucalyptus family a wide range of susceptibility to frost; the varieties that will endure your hardest possible frosts are the varieties to choose, other considerations being equal. Many trees are fastidious as regards soil. Macrocarpa, for instance, hates a clammy, badly drained soil, while with thorny acacia it is hard to say where it will thrive and where it will not until you try it. It is quite a mistake to suppose you can grow good thorny acacia on your worst and most exposed situations; the borer will soon convince you of that error. Nature has provided trees which will flourish under every conceivable condition that can obtain on farming land; it is only necessary to choose with discretion, and no better guide in this direction can be found than observation, both of the successes and the failures in the neighbourhood.

The best time of the year for tree-planting is the autumn or the early spring—not the very depth of winter—and the best year to start planting, if not already started, is 1933. If money is too scarce this winter, seedling eucalypts can be raised ready for 1934.

NEED FOR SYSTEMATIC INVESTIGATION.

In conclusion, I want to point to the necessity of careful systematic investigation into this subject of utility timber production. The information available is most vague and unsatisfactory. There must be thousands of valuable fence-posts burnt as firewood every year for want of a little exact knowledge, and also many thousands of posts put into the fences or yards only to fall to pieces in a few years. For example, I know that E. botryoides or saligna posts split from eighteen-year-old trees will be rotten in seven years, because I have tried them. I know that posts from mature trees of these species are durable because good authorities tell me they are durable. But no one can tell me at what age the tree is mature enough to furnish lasting timber. There are now literally hundreds of thousands of eucalypt trees in this country in the sapling stage. We assume that such saplings are of no value and we burn up our plantation thinnings. But sapling macrocarpa or thorny acacia will last well. Are we quite sure that none of the eucalypts are equally durable or can be made so by preservative treatment?

We have a very modest, very inadequate trial under way in Poverty Bay, now in its eighth year. Too early for results, you might say, but already we have interesting and valuable information of the few varieties we were able to collect. We know, for instance, that E. botryoides posts from an eighteen-year-old tree are rotten, that viminalis from a forty-six-year-old tree are partly decayed, while Macarthuri from a forty-six-year-old tree show no sign of decay; that globulus or blue gum posts from a sixty-year-old tree are as sound as a bell, while redwood from a fifty-year-old tree are done for; and a great many more such indications.

What is needed is a comprehensive test of all the timbers that are being grown privately and publicly to-day, or which are being recommended for private planting. The timber should be tested at various ages and in various soils, with and without preservative and with various preservatives, and such a test should be inaugurated now. The plea that it is too long a time to wait for results is exactly the plea that prevented such a test being undertaken twenty years ago—and will be advanced twenty years hence. And it is a false plea, because results begin to appear when the first post begins to decay.

It is difficult to say whose function it is to inaugurate investigations. They could probably be conducted more economically and more efficiently by the Forestry Department than by any other body, while exact and comprehensive knowledge might help the Department in marketing their timber in the future. But the tendency to load Government Departments with such responsibilities is very objectionable, and I venture the suggestion that local agricultural and pastoral associations could hardly render a better service to the farming community than by undertaking this task. The work of each association could be made part of a comprehensive scheme, and results would cover all variations of soil and climate in the Dominion. The associations have the facilities and the ground space available and can, as a rule, depend on the assistance and co-operation of the farmers.

I sincerely hope that sufficient interest in the subject of tree planting exists to ensure that the question of adequate investigation will be no longer delayed.

SEASONAL NOTES.

THE FARM.

Pasture Top-dressing widely advisable.

In the March notes the justification for expenditure on top-dressing under the circumstances then obtaining was outlined. Meantime nothing has happened to alter in any essential respect the position as then stated, but there has been a considerable reduction in top-dressing in comparison with recent seasons.

It is known that this reduction is more often attributed to financial circumstances than it is really due solely to such circumstances. It is known also that if the reduction is persisted in the financial circumstances will at times become progressively worse despite, and indeed because of, the smaller outlay resulting from reduced top-dressing. Often top-dressing, correctly viewed, is to be looked upon not merely as a means of bringing about increased returns, but also as a means of avoiding decreased returns. Even on land of relatively high quality, pastures which have been built up by top-dressing will without this aid decline just as greatly as they have been built up. In other words, because of judicious top-dressing the swards on many farms are superior in vigour and composition to those the land is naturally capable of supporting and to which there will be reversion if top-dressing is omitted. In many districts a definite association may be expected between decreases in top-dressing and increases in brown-top, flat weeds, and other inferior pasture plants.

Hence, even if top-dressing seemed unlikely to be profitable in respect to its immediate results, it might easily be justifiable as a maintenance measure. But usually there is no conclusive evidence that it is likely to be unprofitable in its immediate results. In fact, the available evidence usually points to profitable results within the coming season, unless the values for such farm produce as butterfat and lamb drop substantially below the prices obtained in the 1932–33 season. Both in meat and in butterfat top-dressing has often been the primary cause of increases of 25 to 50 per cent. in production, and at times the increases in production have been still greater. Many farmers would do well to heed what such increases mean, not only in cost but also in value, before deciding to dispense with the assistance of top-dressing.

Lest it be thought that top-dressing is being advocated without due weight having been given to varying circumstances, and also in order to indicate the position fully, it is necessary to state that there may be cases in which top-dressing has been carried out profitably and in which it could not now be carried out with profit. But because fertilizer prices have fallen as well as farm produce prices, and almost correspondingly, such cases are not nearly as numerous as some seem to believe; they may be expected to occur mostly on land which at no time gave a really handsome return from top-dressing.

This is true relatively often of land of naturally low production. Such land may respond so strikingly to dressings of 2 to 3 cwt. per acre of phosphates that its production is doubled, but doubling its production may not, at times, be equivalent in net gain to increasing the production of fairly good land by 30 to 50 per cent. Viewed another way, if the annual production of land valued at £6 to £8 an acre is increased 100 per cent. by top-dressing costing 10s. an acre annually, then either the value of the land is assessed at too low a figure or the top-dressing is too expensive;

whereas if top-dressing costing 10s. an acre increases by 50 per cent. the production of land valued at £30 an acre, then top-dressing is well justified in comparison with the value of the land; and, further, a 25 per cent. increase in land worth £60 an acre is just as valuable as a 50 per cent. increase in the case of land worth £30 an acre.

It may be accepted that an unprofitable increase of 100 per cent. on the poorer land would be a much more striking result visually than a profitable increase of 25 per cent. in the production of the better land. Actually, known increases due primarily to top-dressing often exceed the suppositious ones discussed above for the purpose of illustrating the advisability of, as far as possible, measuring the returns from top-dressing in terms of net cash rather than of comparative visual results.

Top-dressing, which gives increases of growth that could be turned into a handsome profit, may nevertheless prove distinctly unprofitable in practice. This is because top-dressing, even when judicious, cannot stand alone, but must be linked with effective utilization of the additional feed it provides. If top-dressing is allowed to intensify the lack of control of growth during summer, then much of the potential return from that top-dressing is not realized, and, indeed, the top-dressing may lead to some extent to undesirable results. This fact is of seasonal importance because during winter measures designed to facilitate better summer utilization of pastures, such as the construction of ensilage pits and trenches and further subdivision, can often be carried out more conveniently than later on.

If top-dressing still remains to be done, and especially if supplies of fresh growth promise to be short in the early part of the season, then superphosphate should almost invariably be used at this time. Field trials have shown that superphosphate will often make its influence felt substantially in four weeks from its date of application at this time of the year. Under some circumstances the use of other forms of phosphatic fertilizer may be advisable, and at times the use of supplements to phosphates, such as materials containing lime, nitrogen, or potash, may be worth while. The use of such materials has been discussed in recent notes, and further information about them may also be obtained from district officers of the Fields Division. In general, the first consideration is the supply of phosphates.

Grass Harrowing, &c.

On fields on which the accumulated manure has not been thoroughly broken up and distributed the spring pasture growth is likely to be very uneven, because of the development of rank patches in the vicinity of where droppings were undisturbed for a considerable period. Such rank growth militates against good grazing management in the summer. On farms carrying sufficient store stock which it is not desired to fatten immediately such stock may be forced to eat out the rank growth, but on farms supporting principally "wet" stock it is not at all easy to deal satisfactorily with the rank patches. On such farms it is particularly desirable to avoid them by timely and thorough grass harrowing. Hence harrowing in July and August is likely to be specially serviceable.

Young pastures, and particularly those originating from the use of permanent pasture seed mixtures, should be treated with special care during winter and early spring. Two faults to avoid are undergrazing and overgrazing. Undergrazing is specially undesirable if there is present a considerable amount of Italian rye-grass, which, if allowed, will readily outgrow and weaken more persistent species in a permanent pasture.

Planning Supplementary Crops.

It is not desirable to delay much further the planning of supplementary crop production. Dairy-farmers generally should plan to obtain a supply

of fresh young non-woody feed to supplement the relatively scant supply available from pastures from about Christmas onwards for several weeks. Frequently the special provision made for the period becomes ready too late—it is not always realized that the summer shortage of fresh feed begins so early as it normally does. Frequently the shortage is reflected in the reduced butterfat production soon after Christmas. This may be avoided by having available (1) soft turnips obtained by sowing early a quickly-maturing variety, (2) a fresh aftermath of grass on a paddock on which early ensilage was practised, and (3) young green lucerne following a first cut of the crop removed in good time.

For the special provision of winter feed several courses are open. Despite substantial recent advances in the popularity of ensilage, there remains much scope for its extended adoption, especially in sheep-farming. On many farms on which ensilage already has been practised it could with advantage be practised more extensively. Many would find it profitable to prepare at this season pits or trenches for use in ensilage in the coming summer.

The mangel as a source of winter and early spring feed is not employed nearly as extensively as its merits warrant. In planning for it, it is well to note that it responds especially well to high fertility and good treatment, and, conversely, it yields very indifferent results under indifferent conditions. Those farmers who consistently produce crops of 60 tons an acre and over, under widely varying conditions, provide striking testimony that the mangel can be made a very cheap source of feed by suitable management. In this management two of the main features are (1) the use of land of relatively high fertility, which if not natural is provided by the adequate use of farm or artificial manure, and (2) the early and thorough preparation of the seed-bed, which at times could well be commenced at this season.

In our special cropping a larger place might be given with great benefit to lucerne, which serves very usefully as a source not only of summer green feed, but also of nutritious hay for the winter, and also often provides, from the first cut of the season, silage which is of value for summer or winter use. Although best results are generally obtained from sowing lucerne in November or December, preparation of the seed-bed should commence much earlier, as both fineness and firmness in it are desirable.

In selecting the site for lucerne it should be remembered that the crop is not well able to battle against weeds in its early stages. On this account it often may suitably follow old pasture instead of one or more arable crops during the raising of which the weed content of land may readily be increased. If lucerne is to follow old pasture the land should be skim-ploughed in the early winter and then ploughed, and this once only, in the spring. By this means surface weed-seeds are usually well buried, and the troubles of the young lucerne from weeds correspondingly reduced. Lucerne thrives on fertile well-drained soil and merits the best situation available on a farm.

Previous occurrence of crop disease should be taken into account in drawing up a cropping programme. It is merely courting trouble to sow cruciferous crops, such as turnips, swedes, and rape, on land on which club-root has attacked recent crops, although the use of resistant varieties such as the Herning swede relieves the position to some extent. Chou moellier also does not suffer severely from club-root and, though attacked, has produced splendid yields on land known to be heavily infected. Dry-rot of cruciferous crops is also likely to be carried over from one crop to another. Onion mildew, potato blight, take-all of wheat and barley, and collar-rot of peas, are other instances in which one crop is likely to be infected by germs carried over from a previous one.

The fact that provision of winter feed is so frequently inadequate makes the seasonable task of planning this provision one of considerable importance. In general, the most advantageous course to improvement lies in greater exploitation of ensilage, mangels, and lucerne.

General Cropping Work.

As far as possible, grazing of established lucerne—and this especially in winter and early spring—should be avoided. Grazing facilitates the invasion of lucerne by rye-grass, Poa annua, and white clover, which, being detrimental competitors, are really weeds in lucerne.

Cultivating of established weedy lucerne may be advisable at this season, but generally it is inadvisable unless the conditions allow the weed population to be reduced substantially without unduly injuring the lucerne itself. Top-dressing in early spring of lucerne heavily invaded by grass is usually inadvisable ; normally it is better delayed until the first cut has been removed.

Italian rye-grass or Western Wolths, which often can be sown successfully at the end of August, may be employed as a special forage to provide hay or silage, if necessary. According to locality, artichokes may be sown in mid-August or September ; they thrive on land naturally suited to potatoes, but will also yield well on relatively poor light soil, provided they are liberally manured. From 8 to 10 cwt. of seed per acre, sown about 2 ft. apart in the rows, with rows about 3 ft. apart, are required.

The ploughing of land intended for cereals should take precedence over almost all other work ; as a rule the best yields of spring wheat result from sowing in August and early September. The sowing of oats should ordinarily follow that of the wheat as opportunity offers.

When it is intended to produce chaff or grain from autumn-sown cereals, the final feeding-off should take place towards the end of August. An exception arises in crops on such rich ground that lodging may be expected ; with these the final feeding-off may often well take place in September. Ordinarily, after the final feeding-off, a stroke or two of the tine harrows is of value as a means of loosening the trampled surface-soil and of scattering stock droppings. Spring feeding-off of cereals should be done by heavily stocking for a relatively short period, and this as far as possible when the land is not too wet.

Seed treatment for disease control of spring-sown cereals should not be overlooked. The treatment of seed of oats and barley is more neglected than that of wheat, but nevertheless is well justified. Full information regarding suitable treatment is available from the Department of Agriculture—unsuitable treatment may readily be either ineffective or productive of costly failures of seed.

—R. P. Connell, Fields Division, Palmerston North.

THE ORCHARD.

Control of Pests and Diseases.

For the control of fruit-tree pests and diseases it is of great importance that the identity and life-history of each pest be known ; without such knowledge it is impossible for a grower to arrange and carry out the season's spraying programme with any degree of confidence. The chief pests are (1) insects, and (2) low forms of plant-life known as fungi. In addition to these, mosses and lichens which grow on the bark also do damage by lowering the vitality of the tree and harbouring insect pests, &c. In order to get rid of the moss and lichen a cleansing wash must be used, either in the winter or early spring. Lime-sulphur 1 per cent., or bordeaux 5–4–50, is recommended for this purpose.

The insect pests are of two kinds—biting and sucking : Biting insects are provided with mouth-pieces or jaws. They obtain their food by eating the solid parts of the plants—*i.e.*, leaves and fruit. To control such insects, an internal poison insecticide, such as arsenate of

lead, is applied just prior to the emergence of the insect. Take codlin moth as an example: these emerge from pupæ in the form of a coppery-tinged moth at intervals of about eighteen days throughout the spring, summer, and autumn. The moth herself does no harm; her object in life is to reproduce her kind. This she does by laying eggs; each female moth lays from fifty to eighty eggs before her life's work is finished. The first flight of the season coincides with the fall of the petals, and at this time the moth lays one egg in the calyx of the embryo fruit. In a few days' time the calyx closes, and in doing so protects the egg—incidentally, also, the young larva which subsequently emerges therefrom and which is responsible for the damage to the fruit.

The first application of arsenate of lead, (powder) 1½ lb., (paste) 3 lb., to 100 gallons water should be applied before the calyx closes. As this emergence of the codlin moth from the pupa takes place every two or three weeks throughout the season, it is necessary to repeat the arsenate of lead application every eighteen to twenty-one days, the object being to keep the foliage and fruit of the tree well covered with a film of poison; such applications will also control other eating insect pests which may be present.

Sucking insects have no biting jaws. They are, however, provided with a trunk or proboscis, through which they feed by puncturing the plant tissues and sucking the sap therefrom. To control such insects a contact insecticide is necessary, such as red spraying oil, white spraying oil, lime-sulphur, and nicotine sulphate. Red oil 1–10 applied just prior to bud movement (late dormant period) is recommended for the control of mussel scale, San Jose scale, woolly aphis, and mealy bug, all of which (with the exception of San Jose) emerge from eggs at or about bud-movement period. San Jose, unlike other scaley pests, gives birth to living young. For control of these pests during summer months white spraying oil or lime-sulphur is recommended.

It must be remembered, however, that sulphur in any form must not be applied within at least one week of an oil application. Lime-sulphur dilutions should be made up according to the polysulphide content of the particular brand used. The terms, such as lime-sulphur 1–100 or 1–120, &c., hitherto used when referring to a lime-sulphur solution, will in future be substituted by the following: Lime-sulphur 1 per cent., 0·2 per cent., 0·1 per cent., or 0·083 per cent., according to stage of growth. (See page 265 of the April, 1932, issue of this *Journal* for table of dilutions, relative to this matter.)

Fungous diseases are controlled by pruning out dead or diseased twigs and branches and spraying with a reliable fungicide. The first bud-movement should be recognized by all growers as a signal to take immediate action by applying the first fungicidal solution for the control of black-spot, &c., on pip-fruits, and of brown-rot, bladder-plum, &c., on stone-fruits. It is at this period that many of the spores or fungi seeds which have overwintered by means of hibernating mycelium in cankers on laterals and branches and fallen leaves, &c., become active. No fungi spore can live in sulphate of copper; therefore an application of bordeaux 5–4–50 is recommended as a basal covering, and if applied at the right time (bud-movement) many spores on the point of germinating will be killed outright. Moreover, this spray fluid on drying forms a thin film of sulphate of copper on the tree parts, capable of protecting such parts from spore germination for about ten to twenty-one days according to climatic conditions. The object of this treatment is to apply the fungicide before the spores have had time to reach or begin to grow on the tree parts; therefore it is applied more in the nature of a preventive than a cure.

Spraying Operations.

As the time is rapidly approaching when the spray outfit must once more be brought into commission, it is advisable to overhaul it thoroughly, well before it is actually required for use. Particular attention should be given to the engine and pump to see that every part is in perfect working order. The hose should be thoroughly tested, and if at all weak replaced with new. By taking these precautions much valuable time may be saved later on when every hour counts in applying one or other of the necessary specifics.

Stone Fruits.—As these are usually the first to show bud-movement, they should be the first to receive an application of 5–4–50 bordeaux, followed by an application of lime-sulphur 0·1 per cent. dilution at early pink. Subsequent applications as follows: Lime-sulphur 0·083 per cent. plus colloidal sulphur, 2 lb. per 100 gallons, when 75 per cent. of the petals have fallen. Repeat the latter about every twenty-one days throughout the growing season, according to climatic conditions, until about eighteen days prior to first picking.

Apples.—Apply bordeaux 5–4–50 at bud-movement and again at green-tip. At light-cluster period spray with lime-sulphur 0·2 per cent. dilution, and again at petal-fall with lime-sulphur 0·1 per cent. dilution, plus colloidal sulphur 2 lb. per 100 gallons water. This should be followed by two applications at ten-day intervals, and thereafter at three-weekly intervals up to the end of January, when the period between sprays may be extended if rains, fogs, or heavy dews are not experienced.

Pears.—Apply bordeaux 5–4–50 at bud-movement and again at green-tip. At light-cluster period spray with bordeaux 3–4–50 or with lime-sulphur 0·1 per cent. dilution. Spray at petal-fall either with bordeaux 3–4–50 or with lime-sulphur 0·1 per cent. dilution, plus colloidal sulphur 2 lb. per 100 gallons water. This should be followed by two applications at ten-day intervals. Thereafter at three-weekly intervals up to the end of January, when the period between sprays may be extended if the weather proves dry and heavy dews or fogs are not experienced.

The success of disease control not only depends on spraying with the correct mixture, but applying it at the correct time with sufficient force to drive it into every corner and crevice of the tree. Even this is inadequate unless the operator is thorough and every twig, leaf, fruit, and branch of the tree is well covered.

—*J. W. Whelan, Orchard Instructor, Palmerston North.*

Citrus Culture.

It has been found that with trees allowed to develop unaided by pruning, after bearing for several years, the limbs making up the framework grow haphazardly, frequently crossing each other. Producing lemons for the market under such conditions is considered less profitable than under the correct system of pruning, because of the high proportion of coarse or rough type of fruit present, and the large number blemished by abrasions. In addition, the colour of fruit borne on self-developed trees is inferior, being very yellow when mature.

Lemon trees bear their fruit mainly on the laterals (differing in this respect from oranges), and also to some extent on the terminals of fruiting twigs. The free development of laterals in the interior of the tree is mainly determined by the position of the limb and its accessibility to light. A fairly open centre with limbs sloping outwards as much as possible is recommended, in order to allow more sunlight to enter the

middle of the tree. This forms a denser growth of foliage and the production of new fruiting wood closer to the framework of the tree, shortening the side branches and laterals as much as possible. The development of laterals along the limb should not be suppressed as in the case of mature orange trees.

The first main pruning should be done early in spring, up to blossoming time, and the earlier it is done the stronger the subsequent growth will be. The second pruning should be done from two to three months after the completion of the first. On very vigorous trees a further pruning may be necessary two or three months after the second pruning, and these operations should suffice.

—L. Paynter, Orchard Instructor, Auckland.

POULTRY-KEEPING.

The Hatching Season.

BREEDERS are reminded that August and September may generally be regarded as the best months of the year in which to hatch out chickens. For those who conduct the business on a small scale I advise leaving the hatching of White Leghorns till September, but having all chicks of the heavier breeds in the brooder by the end of August.

With the natural mother, it will be found a wise course to make provision for cosy coops and runs where the chicks may be hatched and reared to a safe age. A common practice is to set a hen in a confined box where she must necessarily be lifted off once a day to feed, drink, and dust herself, as well as for the purpose of keeping the nest clean. It is, however, a much better plan to set the hen in a coop with a roomy run attached. She can then have before her at all times all she requires, thereby minimizing the time required in attending to her, and also the risk of having the young birds carried away by cats, rats, weasels, &c. It is necessary, when the chicks are hatched, that the coop be placed in a dry sheltered place and be continually moved about, so that the conditions may be as perfect as possible.

With all young developing life cleanliness is imperative. A hen cannot hatch and rear her chicks properly if she is a prey to vermin. Chickens hatched under such conditions are handicapped for life. How often one hears of the good hatches a hen will bring out when she makes her own nest in some secluded corner under natural conditions. It is not to be wondered at, as she chooses the very best conditions, and generally has not to contend with the annoyance from parasitic life. When sitting hens are placed under fairly natural conditions and are given every opportunity to rear their young in comfort equally good results should be obtained. It is imperative that the coop be watertight, while provision for the admittance of light and fresh air should not be overlooked. Lack of fresh air is a common cause of a hen refusing to take her brood into a coop, and is often responsible for mortality in chickens when she is forced to do so.

Do not neglect to see that the hen is free from vermin. Many fowls leave their eggs just when they are on the point of hatching because they are being pestered beyond endurance by lice. Before the hen is set she should be dusted with insect powder. The birds may also be freed from vermin by dipping a feather into nicotine sulphate and drawing it under both wings, or by putting a small amount between the breast feathers. A dust bath should also be provided, so that she can free herself of vermin in nature's way. Care must also be taken to see that the coop is free from red-mite. A good spraying with strong disinfectant will ensure this.

When making the nest, place 3 in. or 4 in. of moist earth in one corner of the coop. The earth may be kept in place by means of four bricks. Shape the nest so that the eggs will have a slight tendency to roll to the centre, care being taken to see that it is roomy and flat in the centre. This will allow the hen the necessary room to turn the eggs, which she does several times a day. Neglect of this rule is a common cause of eggs being broken and poor hatches resulting. The nesting-material may consist of fine dry grass, hay, or fine straw. A good plan is to first put the hen on a few china eggs until satisfied that she can be entrusted with the eggs intended for hatching. When possible use a medium-sized hen, as there is less risk of the eggs being broken or the chicks being trampled to death than when a large one is employed.

During hot dry weather it is a good plan to keep the soil under the nesting material slightly moist, especially at pipping time. The heat of the hen's body will draw the moisture to the eggs and prevent the skin just inside the shell of the eggs from becoming too tough and dry for the chick to pierce—a common cause of fully developed chicks dying in the shell at the pipping stage. When the eggs commence to hatch do not interfere with the hen as she can manage best by herself. It is only courting trouble to take the chicks out of the nest as they hatch. They should be left to the care of the hen.

When the hatch is completed the hen may be given a feed of grain, preferably out of a tin or something similar, but there should be no hurry to feed the chicks for at least twenty-four hours. The egg-shells should be removed and the nest made comfortable, one of the bricks being also taken away so that if a chick jumps out of the nest it may easily return to it. Many chicks are drowned by jumping into deep water-vessels, and this risk should be minimized by using a shallow water-trap, or better still a drinking fountain specially made for the purpose of providing young chickens with drinking water. The food for sitting hens should consist of whole grains, such as a mixture of whole wheat, maize, or oats. This, with grit and clean water, is all that is required.

Artificial Incubation.

Hatching chicks by means of incubators is a simple matter to the person of experience, but it is one of the most difficult matters on which to guide the novice by means of printed advice, chiefly because no two incubators on the market require exactly similar treatment. The best advice to the novice is that before starting he should carefully study the instructions sent out by the maker regarding the particular machine he intends to use. He would also be well advised to select an incubator from among those makes that have proved their value to successful poultrymen, rather then be led into buying an out-of-date or second-hand machine because it is cheap. Too often the latter are minus some important parts in the regulating device, &c., which are probably not obtainable in the Dominion, with the result that the so-called cheap machine proves an expensive thing in the long run. Even with the best makes of incubators it is never safe to depart from the maker's instructions until the operator has had considerable experience in incubator work, or when he is following the advice of a man of wide knowledge in artificial hatching.

With all makes of incubators there are certain rules that must be observed if success is to follow. The most important point is that the correct range of temperature must be maintained throughout the hatching period. This implies that the temperature registered is being expressed in the right place—that is, in a line with the top of the eggs. The germ of an egg floats uppermost, irrespective of the position in which the egg is resting, thus the necessity for having the bulb of the thermometer resting on a fertile egg will be seen. The great aim should be to have the eggs commencing to pip on the twentieth day and hatch on the twenty-first day. It may be mentioned

that stale eggs will always take longer to hatch than those that are fresh, and allowance must be made for this. Eggs intended for incubation should be placed in the incubator as soon after being laid as possible. It is true that chicks can be hatched from eggs a month or more old, but usually the chicks produced from these are delicate and difficult to rear. Eggs which are to be used for hatching should be gathered at least twice daily, especially during long days when hot weather conditions prevail, as several hens following one another in the same nest may easily start the process of incubation in the eggs first laid, with the result that such eggs will be useless for hatching purposes.

As regards temperature, this should be maintained at about 102° F. for the first week and 103° F. for the second and third weeks. The aim should be to see that the temperature never falls much below 101°, nor higher than 103°. If after following this range of temperature the eggs do not pip up to time the only safe course to take with the following hatch is to work a degree higher, as it indicates that the thermometer is not registering the correct degree of heat in the incubator. Every care should be taken to prevent an excessive degree of temperature, or trouble may be expected with the chickens hatched during the brooder stage through the yolk failing to become absorbed. The yolk is drawn into the body of the chick just before it leaves the shell, and under proper incubation conditions the yolk in its sac will be found in a more or less liquid state, enabling it to run freely and finally to become absorbed. On the other hand, where the temperature has been allowed to go too high during the whole or part of the incubation period, the yolk becomes half baked, rendering it impossible of absorption, from which cause mortality during the brooder stage is likely to take place.

Prevention is the one thing to aim at, and the first essential in this connection is the maintenance of an even temperature during the incubation period.

Exported Eggs and Pale Yolks.

In regard to the 5,264 cases of 30-dozen each exported to the London market last year, it is gratifying to know from reports to hand that the eggs generally opened up in excellent condition and were favourably commented upon by buyers. It may be well, however, to draw attention to a complaint received regarding some of the eggs shipped that contained pale-coloured yolks, in order that producers may do everything possible to avoid a similar complaint with eggs shipped during the forthcoming export season.

Yolk colour is largely influenced by the food supplied to the birds. The inclusion in the ration of red carrots, yellow maize, watercress, lucerne, clover, and meat will all tend to produce rich-coloured yolks. Reference is now made to birds that are being kept under confined conditions, as it is well known that eggs containing pale yolks are seldom produced where birds are provided with a free range and natural conditions generally. The sickly appearance of the yolk of eggs from birds confined in a yard without a liberal supply of vegetable matter and animal food has done much to discourage the use of eggs on the local market, and consequently cause a reduced demand for this product. This in itself is a serious matter from an industry standpoint, but it is even more serious when catering for the overseas market, on which our eggs have to face keen competition.

Poultry-keepers should heed the warning and set themselves out to feed and manage their birds in such a way that the eggs produced will contain a desired yolk colour when they reach the export grading stores. It should be remembered that the good name our eggs possess on the London market if once lost will be hard to regain.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

Making a Start with Bees.

IT is often asked what is the best time of the year to make a start with bees. There is no better time than in the spring, firstly because there is little advantage to be gained in purchasing hives in the semi-dormant period when the activities of the bees are at their lowest, and little can be done then by the beginner to probe the mysteries of the hive. Secondly, in making a start in the spring the beekeeper can immediately engage in the practical work, which, after all, is the most interesting and absorbing side of beekeeping.

Until an opportunity has been afforded to open up the hives the beginner will not be able to put to the test any knowledge he may have acquired by a course of reading. Preparatory to making a start the beginner should first of all get acquainted with the rudiments of the art; in any case, he should know something of the hive and its parts, the inmates of the hive, and something of their life-history. This elementary knowledge is best obtained from some reliable text-book on the subject. The beginner, however, will find much of the information he requires in that useful bulletin published by the Department of Agriculture entitled "Beekeeping." At any rate, the information contained in the bulletin should suffice to tide a person over the difficulties likely to be met with during the first season, and enable him to grapple with the many problems which may have to be faced before it is completed. Later, should he decide to extend his theoretical knowledge, he can then obtain a more advanced work on the subject. However, it is well to warn the beginner that until he has grasped the rudiments of beekeeping it is a disadvantage to acquire too many conflicting opinions on the subject, as these tend to confuse, and lead to blunders and expense which could have been avoided if the advice given in some reliable text-book had been followed.

Since spring is the best time for starting beekeeping, no time should be lost in making the necessary arrangements for the purchase of stock. It is immaterial whether a start is made with Italian or Black bees, but if Italian bees can be purchased as cheaply as Blacks, then a start should be made with them. If bees are obtainable locally the prospective beekeeper can make arrangements for the purchase of established colonies, or he can wait until swarming-time, when swarms are available. Perhaps the most satisfactory way is to purchase some established colonies from a neighbouring beekeeper and move them home before too much brood is present in the hives. No harm will come to bees moved in the colder months, the same provision for screening not being so essential as when moved during the summer months. Screening the hives top and bottom is not necessary if the bees are moved only a short distance, and if the beekeeper takes the precaution of tacking a piece of wire gauze across the front entrance, this will prevent suffocation and make for safe handling in transit.

The beginner will be well advised to procure only strong healthy colonies from a reliable beekeeper who can furnish a guarantee that the bees are healthy. Upon this depends much of his future success. The keystone to this condition is the permit issued by an Apiary Inspector under the Apiaries Act. The first question to be asked by the beginner of the seller is, "Have you the necessary permit to sell?" If this is forthcoming he may rest assured that he has a reasonable chance of getting clean bees, apart from any of the other conditions which go to make a good hive. Although the purchase of first-class colonies is probably the most expensive way to commence beekeeping, they have the advantage that they are more easily kept

in order than colonies which have been neglected, and which require to have corrected the faults of the previous owner who has not learned to make his beekeeping profitable.

Since it cannot be expected that the beginner should know what constitutes a good colony, he should only deal with a beekeeper of some standing. Everything with bees depends upon starting right. The possession of a colony in prime working condition gives the beekeeper a standard with which to compare other colonies, and enables him to avoid costly mistakes in their management. If the cost of starting a small apiary has to be considered, the beginner will find it an advantage to arrange for the purchase of as many first swarms as are wanted. These may be obtained in boxes, and subsequently transferred to frame hives. Only early and prime swarms should be stipulated for, otherwise they will not build up in time for a crop.

The hives when placed in their permanent position should be sheltered and face the north. Protection from cold winds is important, but the hives should not be placed under trees, as this has a tendency to make the bees vicious. The hives should be set on four bricks, as this allows for a free circulation of air under the bottom-boards, which will rot if placed directly on the ground. The hives require to be level crosswise and have a slight cant lengthwise. This prevents driving rains from lodging within the hives, which is likely to render the combs mouldy. A watertight roof and sound bottom-board are just as essential to the welfare of bees as are good floors and roofs in human dwellings.

A certain amount of working equipment is necessary. However, if provision is made for a smoker, bee-veil, hive-tool, and a pair of gloves, such other articles can be added as they are needed. Until such time as the beginner has got used to the stings he will find it an advantage to wear gloves, although he should accustom himself to do without them. In the course of time gloves become impregated with poison, and this will irritate one's flesh on hot days; moreover, it is resented by the bees. There is much difference in the temper of bees, Blacks being much more troublesome to handle than Italians, but with a little care in carrying out hive manipulations and the free use of smoke most colonies can be handled with very few stings.

If the beginner desires to start with established colonies, it is reasonably sure that he will have to make provision for the increase that will take place. Under normal conditions swarms are sure to issue unless the hives are manipulated to prevent them. Consequently extra hives and frames should be got in readiness. These can be purchased in the flat and put together, so that no time will be lost when the first swarms come out. For each swarm of bees a complete outfit will be required, consisting of one bottom-board, one body-box, one roof, ten Hoffman frames, one half super, seven section frames, twenty-eight sections, and about 2 lb. of comb foundation. Additional half supers will be required to place on the established colonies to permit of storage room for surplus honey.

Having got together the necessary bees and equipment, the beginner can then turn his attention to the practical side of the work. Before opening up a hive everything should be in readiness. The smoker should be going well, and the operator would be well advised to protect himself with a good bee-veil properly adjusted. Attention to these details is absolutely necessary, otherwise the bees may drive him from the hive, particularly if the bees are bad tempered.

I have already referred to the free use of smoke, and by this it is not meant that the bees should receive an overdose, as this may demoralize

them and render them liable to attack from other colonies. Moreover, it does not bring them under control, but tends to aggravate them. It has the further disadvantage that as the bees are driven from the combs they form in clusters on the bottoms of the frames and the sides of the hives, making it well-nigh impossible to locate the queen and to carry out other essential work with any degree of success.

The best fuel for the smoker is dry clean sacking, no other material being as good. Avoid oily waste and cotton materials, as the smoke from these articles makes the bees vicious. When handling bees all operations are best carried out in a gentle manner, avoiding at all times quick movements and clumsy manipulations which may crush bees. It must be remembered that nothing irritates bees more than the odour of the poison which fills the air when any of their kind are crushed.

Early Spring Examination of Hives.

With the advent of milder weather advantage should be taken of fine days to make a preliminary examination of the hives. Provided that the colonies were queen-right in the autumn and had ample stores for the winter period, very little harm can come to them during the opening months of the spring. It is not sufficient, however, to conclude that all is well because the bees are flying freely and numbers of them are carrying pollen into the hives. These activities obtain even up to the point of starvation, and if taken as a guide to the condition of the hives, wholesale losses may result. To ensure, therefore, that all is well and conditions right for the progress of the colonies, a critical examination should be made as early as possible. Although it is an advantage to postpone the spring examination until the bees are working fruit bloom and early nectar plants, if it is thought the colonies need attention the work should not on any account be delayed. It must be remembered that the drain on the stores is enormous once brood-rearing has commenced.

When starting to manipulate a hive puff a little smoke in at the entrance, and having removed the roof puff a little more smoke in the frames as the mat is peeled off. This operation being complete, bring into use the hive-tool for the purpose of crowding the entire set of frames to one side of the hive. This has the effect of widening the space between the side of the hive and the first frame to be taken out. Then prize the first frame loose from the next one, which will leave it free to be lifted out. The first comb to be taken out should be placed in an empty super and covered to prevent robbing while the other combs in the hive are being examined. Next prize the balance of the frames apart one by one prior to making an examination of the whole. As each comb is being examined and put back the operator should watch the behaviour of the bees, and if they show signs of assembling in close formation between the top bars of the frames watching his movements they should be driven down with a little smoke.

Usually the combs in the middle of the hive will reveal the household activities. If the hive is in normal condition the centre combs will contain brood in all stages, while at the top of the comb or in the upper corners there may be patches of sealed honey. In addition to the sealed honey there will probably be a considerable area of sealed brood. The beginner can determine the difference between honey and sealed brood by removing some of the cappings. However, with a little experience he will be able to distinguish the difference by the appearance of the cappings. In the cells adjacent to the sealed brood the older larvæ may be seen as white grubs coiled tightly against the bottom of the cells; in other cells smaller larvæ and eggs. The eggs may be at first difficult to detect. However, by holding the comb in the right light they are easily distinguished on the bottom of the cells. In appearance they are white, and resemble small

pieces of cotton about $\frac{1}{4}$ in. in length. Usually between the brood and the honey may be found several rows of cells containing pollen. This appears usually as yellow, brown, or blue material packed in the cells. It is gathered from flowers, and is used in abundance throughout the breeding season in elaborating the food for the young bees while in the larval stage.

If, however, an absence of brood and eggs is noted, the indications point to a poor queen or that the hive is queenless. To attempt to carry such colonies through the spring months will lead to serious trouble, as they stand in danger of getting robbed out. It is a far better plan to unite such colonies than run the risk of disturbing the whole apiary. A simple method of disposing of weak and queenless hives is to unite them with strong ones, and this may be carried out by placing a sheet of newspaper over a strong colony and putting the hive to be united on the top of the paper. In the course of a day or two the hive may be examined to see that the colonies have united. Should the paper be intact it must be torn in several places, when it will be found in the course of a few days that the colonies are working peaceably together. It is essential that breeding should be kept steadily going, so that the colonies will be strong in young bees to take advantage of the first flow of nectar. Food and warmth are important factors in inducing breeding, and these must have the constant attention of the beekeeper during the spring months.

Spring Feeding.

As already indicated, the spring is the most critical period of the year for the beekeeper, and the success or otherwise of the season's work will depend almost entirely upon his efforts to guard against the losses attendant upon starvation. When breeding is in full swing a considerable amount of food is used up daily for feeding the brood, and, unless the weather conditions are favourable to enable the bees to work the early spring blossoms, it is essential that the food supply be augmented. The amount of nectar gathered when the weather is favourable, in conjunction with their stores, will tide the bees over long periods, but if bad weather follows, colonies will often be reduced to a state of starvation before the owner is aware of their condition. If on examination a colony is found with insufficient stores to meet requirements preparation should be made to feed at once. It is not a safe policy to keep a colony at starvation-point, as this will prevent the rearing of a succession of young bees to take the place of the rapidly dwindling number of workers at this period.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

Plant Pests and Diseases.

THE vast improvement in means of transport all over the world has many priceless advantages; but, as usual, there are a few disadvantages attached to it, and among them are the increased opportunities for the spread of plant pests and diseases. The small size and isolation of this country give it an advantage in this respect, which is a matter for congratulation, as there are a very great number of plant troubles elsewhere of which most of us are blissfully ignorant; but there are nevertheless a number here which demand careful consideration by those who would grow good crops.

The first line of defence against losses from these causes is to grow crops that are suited to local conditions of soil and climate, and then to treat them well by planting at the right season in well-prepared ground. The vigour and robust condition of such crops is such a fine antidote to disease that

many who adhere to these principles have very little trouble with their crops, especially when a good system of rotation cropping is adopted with annuals, and all waste material is properly and promptly dealt with.

However, there are a few parasitic insects, fungi, bacteria, and virus diseases threatening, and to effectually prevent loss of crops from such causes it is important to learn by observation and study the habits and life-history of such organisms, for only then can intelligent and economical measures be taken to deal with them. This interesting intimacy with all forms of life reveals its humours as well as its tragedies, and close observation at the right time frequently leads to an easy solution of a problem that might easily be serious if neglected. For these reasons the habits and life-histories of such organisms should be carefully studied. Children do this naturally with great enthusiasm, and they should be assisted and encouraged.

For the control of some insect pests natural enemy insects have been introduced with good effect. There is usually a considerable expense attached to the introducing and breeding of stocks for liberation, but the result is then shared by all growers without further expense. Usually chemical sprays or dusts are used to destroy or prevent the attack of insect pests or fungus parasites. Where a bacterium is concerned sprays are usually of little use, and it is generally necessary to burn up infected material.

The larvæ of moths, beetles, and weevils attacking plants chew their food and may easily be destroyed by poisoning: for this purpose a solution of arsenate of lead is used; or for slugs, woodlice, &c., Paris green is mixed with bran, of which they are very fond. To deal with the larvæ mentioned it is important to know the place and time of egg-laying, as if action is deferred the larva often enters the tissues of the plant and is then beyond the reach of the spray.

Scale insects, aphides, and others pierce the tissues of the plant and feed on the juices. These obviously cannot be destroyed in the same way as the preceding class, but they may be destroyed by sprays such as an oil emulsion or nicotine, or even a soapy solution, which act chiefly by smothering. To be effective all insects must be covered, as those that are missed, owing to their wonderfully rapid increase, quickly establish new colonies. The difficulty is best overcome by repeating the application after the interval of a week or so; and especially by commencing operations so soon as the first signs of an attack are perceived, as many insects, and especially the aphides, often cause, when well established, such distortion and curling of the foliage as to make it extremely difficult to reach them effectively with a spray. Under glass such pests are easily destroyed by fumigation.

Fungus diseases are spread chiefly by means of spores so small and light as to be easily distributed by means of wind or water. During spring-time the distribution is often very active, and unless they are destroyed then they may continue to flourish and cause great damage during the summer and autumn. They are readily destroyed by keeping the plants well covered with a solution of bluestone and lime, known as bordeaux, or some form of liquid sulphur. A good cover of this kind will last for two or three weeks, and should then be repeated as necessary; early spring and autumn are usually the periods when the danger from this attack is greatest.

There are three points to be specially noted in this connection: Firstly, keep the plants in vigorous condition with good culture. Secondly, trees, shrubs, and climbers subject to attack should be properly pruned, to avoid crowded growth, so that they may be effectively sprayed. And, thirdly, all infected wood, foliage, fruit, or other infected waste should be carefully destroyed so far as possible in order to prevent reinfection.

Making a Hotbed.

In a sunny, well-drained position it is not difficult to make up a hotbed for raising half-hardy plants for setting out early in the month of November. Tomatoes, egg-plants, chillies, melons, cucumbers, marrows, and celery are among the many kinds that may often be sown with advantage in boxes, towards the end of August, and started on a hotbed. The heat for the purpose is usually obtained from fresh strawy stable manure that has been treated to bring about a general state of fermentation throughout the whole mass. This is done by stacking the material in a compact manner, under cover, and in a few days when fermentation is well established it should be turned, shaken out, and again restacked, damping down any dry material meanwhile. By repeating this treatment two or three times fermentation becomes general. The bed is then made by spreading the material evenly and treading it firmly, building a neat solid stack of the desired height and area. The frame may then be placed in position, and in a few days, when the heat has steadied, thoroughly water the bed, place the glass sashes in position, and it is ready for use. In Northern districts very little material is necessary to maintain the bottom heat of about 50° to 60° F. which is desirable. In colder localities more material will be required to maintain this temperature during cold weather, but assistance can be given on frosty nights by covering the glass sashes with mats. Where stable manure is scarce, the supply may be supplemented with leaves where they are available.

Vegetable Crops.

If treatment as described in previous numbers of the *Journal* has been given, a considerable area of the land will now be in a clean, fertile state ready for planting whenever it may be sufficiently dry. Where the soil is light, and especially in dry areas, it is usually a good policy to plant early crops and make the most of the spring rains; but on heavy land little is gained by being in too much of a hurry, and the greatest care is necessary to avoid working on it while it is wet.

Where the soil is light, rich, deep, and moist in almost any climate here, as it is very hardy, asparagus should grow well, and good selected one-year-old plants may now be planted out; 18 in. apart in the rows and 4 or 5 ft. between rows is the usual spacing of commercial crops. For home use a couple of rows planted 18 in. apart both ways is very convenient. If more is required there should be an interval of 4 ft., when another double row may be planted. When planting open a trench 10 in. deep, set out the plants, and cover to a depth of about 2 in. During the summer, when the plants are growing, occasional cultivation will gradually fill in the trenches until the surface is level. The crowns of the plants will then be 5 in. to 8 in. beneath the surface. If plants are not available seeds should be sown so soon as possible in drills about 2 in. deep, with 15 in. to 18 in. between the rows. Sow thinly to avoid crowding, and good plants will be available for planting another season.

Main-crop carrots and beet are inclined to be coarse if planted early. It is therefore usual to defer sowing them for a couple of months or so; but shorthorn carrots and globe beet may be sown now for harvesting during the summer. Parsnips require a long season and should be sown now; also white turnips, cabbage, cauliflower, parsley, peas, and onions. Early potatoes should now be planted.

Careful inspection made recently in localities where the natural enemy parasites introduced by the Plant Research Station, Palmerston North, for the control of the white butterfly were liberated shows that 60 per cent. of the insects are parasitized. This is welcome news, as it affords good grounds for expecting when both kinds of these useful parasitic insects are well established the white butterfly pest will be well under control.

During moist evenings slugs are often troublesome among seedling plants. The old remedy is to dust the plants at such periods with fresh slaked lime; a bordeaux spray is also a sovereign remedy, as also is powdered alum used as a dust or in solution or mixed with the slaked lime. Two tablespoonfuls of liquid ammonia to 3 gallons of water applied as a fine spray will also destroy them. For large areas a mixture composed of 1 lb. of Paris green and 28 lb. bran, mixed well together and then moistened until it forms a flakey mash, broadcast thinly during the evening will clear an acre of ground of both slugs and cutworms.

Tomatoes, Egg-plants, and Capsicums.

Starting the outside crop and setting out the young plants under glass makes August a busy month for those growing tomato crops. The abundant supplies of this exceedingly wholesome fruit, which is available for the greater part of the year, indicate a high standard of production. Forcing the plants for abnormal crops, over-intensive culture, and planting out in unsuitable land or climate are the chief causes of disappointing results. A great deal of experience is necessary to force the crop to its limit successfully, and it is quite unsuitable for commercial culture on wet land or in a wet climate. Sturdy plants of a suitable variety are the first requisite; these may be obtained by growing them steadily at moderate temperatures in rather a dry atmosphere. This demands a good deal of supervision now, but it saves anxiety and disappointment later. Losses under glass are sometimes due to planting in a dry soil, planting loosely, and chilling the plants during the operation or afterwards. It is at the commencement that this crop demands close attention; by watering the ground well under glass before planting out, and allowing it to warm up, very little further watering is required during a difficult period. Planting deep and firmly secures the sturdy growth of roots and top that is most fruitful, while exposing the plants to cold winds at this season for even a short period will chill them and seriously check their growth. Steady growth without a check is necessary to secure a good setting of fruit on the first bunch.

Egg-plants or aubergines (*Solanum melongena*) and capsicums or red peppers (*Capsicum annuum*) are excellent culinary fruits, which may be sown now on a hotbed for planting out later. They require rather a higher temperature than tomatoes, but should be grown more extensively in warm localities.

Small Fruits.

Bush fruits may still be planted during dry weather in land that has been well prepared. Careful attention should be given to pruning the young plants; this operation was explained in the May *Journal* notes.

The rising temperatures of spring-time rouse fungus and insect parasites from their winter sleep as well as the hosts on which they live. As in many instances the danger from these troubles is greatest at this period, the application of suitable sprays just before growth commences and until flowering takes place is often more effective in controlling disease and preventing damage to these crops than at any other period. Bigger crops and a longer period of profitable production may be obtained by carefully attending to the spraying of these plants during the spring-time and autumn. For the control of leaf-spot and other fungi a 4-4-50 bordeaux spray should be applied shortly before growth commences, and at 3-4-50 strength at intervals of about three weeks, as required, afterwards. In most instances the strawberry crop will also need this spray treatment.

The Homestead Garden.

Where new lawns are to be sown down it may be done now as soon as the land is in condition. Early spring sowing is very desirable in the drier

localities in order to obtain good strong growth before the dry summer weather arrives. The note on surface grades and levels in the February issue is important here, as good appearance depends very largely on the choice of levels and obtaining a smooth surface.

In the warmer districts rose pruning may be completed and a bordeaux spray applied, using 8 oz. bluestone, 6 oz. lime, 4 gallons water. In the colder localities early September will be soon enough to prune these plants. In this section little spraying is usually done and not much is generally required, but unless a careful watch is kept scale insects will destroy a valuable plant or mealy bugs will be found infesting climbing plants in sheltered positions. It is then necessary to thin out the growth by means of careful pruning, and to spray the plants during early summer and autumn with a solution of nicotine concentrate or an emulsion of white oil. Problems of this kind may be referred for advice to the Director of the Horticulture Division, Department of Agriculture, Wellington.

The planting of trees and shrubs should now be completed as soon as weather permits.

—W. C. Hyde, Horticulturist, Wellington.

GRADING OF PIGS SLAUGHTERED AT MEAT-EXPORT AND BACON-CURING WORKS.

THE following notice was gazetted at date 15th June, 1933, over the signature of the Minister of Agriculture:—

As from 1st July, 1933, all pigs slaughtered in meat-export slaughter-houses and bacon-curing works in the North Island and passed as fit for human consumption will be graded by grading officers approved by the Department of Agriculture in co-operation with the New Zealand Meat-producers Board. In carrying out this duty graders will give consideration to the specifications stated hereunder as constituting the types of carcass most exactly suited for both the export and the local trade, but will carry out their duties on such lines as may be from time to time determined by instructions issued by the Department in co-operation with the Board.

PORKERS.

First Grade.—Prime barrows and maiden sows, well finished, satisfactory length, light shoulders, well finished leg to hock. Fat flare must be white and firm.

Second Grade.—Any pigs of sufficiently good quality not passing as first.

Other Pigs.—Pigs passed as fit for human consumption to be classified by the grader and approved by the Inspector as suitable for the export trade or otherwise.

Freedom from taint imperative in all grades.

Porkers to be classed on weight in three divisions as follows: 60 lb. to 80 lb.; 81 lb. to 100 lb.; 101 lb. to 120 lb.

BACONERS.

First Grade.—Prime barrows or maiden sows. Length: The minimum length from aitch-bone to first rib—26 in. for pigs weighing from 121 lb.–130 lb., 27 in. for pigs 131 lb.–140 lb., 28 in. for pigs 141 lb.–160 lb., 30 in. for pigs 161 lb.–180 lb. (dead-weight). Fatness: The maximum thickness of back fat at shoulder not to exceed 1¼ in. in pigs weighing 121 lb.–130 lb., 1½ in. in pigs weighing 131 lb.–140 lb., 1¾ in. in pigs weighing 141 lb.–161 lb., and 2 in. in pigs weighing 161 lb.–180 lb. (dead-weight). Finish and conformity: Neck and shoulders not too heavy; well finished from leg to hock; satisfactory thickness of flank. Fat to be white and firm, free from any oil, fish, or meat taint.

Second Grade.—Lacking in above good points, *e.g.*, overfat, heavy neck and shoulders, short loin, bad conformity, thickness of bone.

Other Pigs.—Pigs passed as fit for human consumption to be classified by the grader and approved by the Inspector as suitable for the export trade or otherwise.

CONSOLIDATED DAIRY REGULATIONS.

ADDITIONAL PROVISIONS SUMMARIZED.

THE General Regulations under the Dairy Industry Act, 1908, have been recently consolidated, and certain amendments made by way of additions. The provisions of the amending regulations may be summarized in handy form as follows :—

(1) On and after 1st August, 1933, all milk for butter and cheese making to be graded and paid for according to grade.

(2) After 1st October no grading of milk to be done by any person other than a certificated milk-grader.

(3) Milk for butter-making to be graded into one of three grades—namely, Finest, First, or Second grade.

(4) Milk for cheese-making to be graded into one of two grades—namely, First or Second grade. Provision is made, however, for an additional grade as Finest if deemed necessary.

(5) Milk for butter-making may be graded by one of five tests—namely, (*a*) the curd test, (*b*) the reductase test, (*c*) the microscopic test, (*d*) the curd test plus the reductase test, or (*e*) the curd test plus the microscopic test.

(6) The standards for grading are duly set out.

(7) Supplies of milk must be tested daily.

(8) Payment for graded milk for butter-making to be at the rate of at least ½d. per pound of butterfat more for Finest grade than for First grade, and at least 1d. per pound of butterfat less for Second grade than for First grade.

(9) Payment of graded milk for cheesemaking to be at the rate of at least ½d. per pound of butterfat more for First grade than for Second grade, and in the event of any milk being graded Finest grade a higher rate than that paid for First grade may be paid if thought fit.

(10) Between the period from 1st August to 31st May no supplier to a butter or cheese factory may change to another factory without the consent of the factory to which he has been supplying milk or cream.

(11) Night's milk must not be delivered to factories at a temperature exceeding 65° F.

(12) Factories must not accept milk in the forenoon after 9 a.m.

(13) Dairy utensils on farms and in factories to be protected from rodents, birds, &c.

(14) The fat column of Babcock milk and cream tests to be read after the bottles have stood for three minutes in a bath of water at a temperature of 135° to 140° F.

(15) Babcock cream test bottles submitted for testing should be 9 grams, 50 per cent. graduated to ½ per cent. on body of usual size for 18 grams.

(16) The period during which factories may test samples of suppliers' milk or cream twice a month instead of at the customary ten-day intervals has been extended to include May in the North Island, and for that Island now covers May to August, inclusive. The South Island months of May to September, inclusive, have not been changed.

(17) Where the weight of cans of cream is not to an exact half pound, it must be recorded at the nearest half pound below the exact weight, and where the weight of the can is not an exact half pound it must be recorded at the nearest half pound below the exact weight.

(18) The tare weight marked on cream cans must be checked at least once each year, and any necessary corrections made.

(19) Cream receiving depots are now classed as Manufacturing Dairies.

(20) Dairy companies are required to furnish each month a return showing the butterfat paid for, and the amount of butter and/or cheese made therefrom.

(21) The temperatures for holding cheese in cool stores are now as follows : August to November, 52° to 54° F. ; December to February, 47° to 49° F. ; March to July, 42° to 44° F.

(22) As from 1st August, 1933, the minimum points for cheese graded First grade will be 91 points.

(23) The requirements with respect to butter boxes and cheese crates have been set out in fuller detail.

The consolidated regulations were gazetted at date 18th May, 1933. Bound copies of the full text, complete with index, are available from the Government Printer, Wellington, at 2s. 3d. each, plus 1d. postage.

—*Dairy Division.*

WEATHER RECORDS: JUNE, 1933.

Dominion Meteorological Office.

Rainfall.—Few, if any, drier Junes can have been experienced in New Zealand than the one just past. The only localities where more than the average rain was recorded were a few places on the east coast between Timaru and Dunedin, and a place or two in the Wairarapa and in South Westland. The average deficit in the South Island was about a third, while in the North Island it was more. Even places on the east coast which had frequent rains had only a small total. The case of Napier, where the rainfall was the lowest on record for June, was especially interesting. Rain was recorded on eleven days, but the maximum fall was 0·05 in. and the total only 0·24 in. In addition, there were traces of rain on eight days.

Temperature.—Temperatures were much below normal, but there were no very severe days. The atmosphere was too humid at most places for frosts to be exceptionally hard, although inland, especially in the South Island, they were numerous. In the interior of Canterbury, however, some very low temperatures were recorded. In many places, as for instance in Central Otago and the coastal districts of Canterbury, the development of fogs checked the fall of temperature at night, but some cold and dismal days resulted.

Sunshine.—Districts exposed to the eastward had much less than the average sunshine, Wellington with 77·4 hours, faring the worst. In the interior and on the west coast conditions were much better. Tauranga had the splendid record of 199·4 hours, and New Plymouth, Nelson, Blenheim, and Hokitika all had well above the average.

Pressure Systems.—Pressure was generally high during the month, especially in the South. There was very little storm activity over the Dominion itself. The most important depressions were of cyclonic form, but in only one case did the track of the centre cross our coasts, and that was on the night of the 1st. This particular storm was a deep one, and its course lay across southern Otago. The rain associated with it was more general and heavier than at any other time during the month.

Two other cyclones formed on the Australian coast and moved slowly eastwards, passing New Zealand to the northward. The first passed on the 9th and the second on the 21st. Still another moved southwards from the region of the Kermadec Islands between the 16th and the 19th. The principal effect of these storms was to produce southerly or south-easterly winds and cold weather over the Dominion. Skies were cloudy on the east coast and over much of the North Island. Misty rain was of frequent occurrence, but there were comparatively few heavy falls. From the 5th to the 8th, southerly gales were experienced at many places. The 6th and 7th were very cold days, and snow fell on the high levels in both Islands, many places receiving a deep coating. There were also numerous hailstorms. Conditions were somewhat similar between the 15th and 17th, although on this occasion there was little snow in the South Island. In the interior and western and southern portions of the South Island fine weather with very light winds and hard frosts predominated. Many fogs, also, were reported.

On the 25th a fairly deep cyclone advanced from the New South Wales coast across the Tasman Sea, and there seemed a prospect of general and heavy rains. But at this stage the storm suddenly began to move southwards and fill up, and, though rain was almost general, the heavy falls were confined principally to the western districts of the South Island. The continued spell of cold weather had, however, been broken, and mild conditions prevailed until the end of the month, while a series of shallow westerly depressions passed in succession. During this period some dense fogs occurred on the east coast, Christchurch being the worst sufferer. On the 30th a dense fog occurred on Manukau Harbour and the Hauraki Gulf.

RAINFALLS FOR JUNE, 1933, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average June Rainfall.
North Island.				
	Inches.		Inches.	Inches.
Kawhia	2·95	14	0·71	6·82
Russell	4·81	9	1·70	6·66
Whangarei	2·35	14	0·71	6·67
Auckland	2·67	15	0·89	4·95
Hamilton	2·64	11	0·67	5·06
Rotorua	1·64	6	0·62	5·23
Kawhia	4·63	14	1·47	5·63
New Plymouth	2·83	16	0·62	5·98
Riversdale, Inglewood ..	5·03	15	0·84	10·29
Whangamomona	5·19	10	1·06	7·81
Hawera	3·57	16	1·20	4·31
Tairua	2·27	11	1·15	7·07
Tauranga	1·46	7	0·80	5·42
Maraehako Station, Opotiki ..	3·14	6	2·17	5·74
Gisborne	3·59	20	1·05	4·97
Taupo	1·76	7	0·57	4·50
Napier	0·24	11	0·05	3·51
Hastings	0·46	11	0·10	3·18
Whakarara Station, Kereru ..	0·45	9	0·09	..
Taihape	2·06	19	0·42	3·43
Masterton	3·00	20	0·62	3·71
Patea	3·40	15	0·81	4·20
Wanganui	2·05	10	0·81	3·33
Foxton	2·23	9	1·10	3·28
Wellington	2·75	17	0·51	4·19
South Island.				
Westport	4·44	14	0·70	8·85
Greymouth	3·89	13	1·03	8·74
Hokitika	4·97	14	1·26	9·30
Ross	8·82	10	1·82	8·70
Arthur's Pass	6·78	10	2·18	10·54
Okura	7·81	7	1·50	10·67
Collingwood	3·96	11	1·89	10·28
Nelson	0·74	6	0·50	3·54
Spring Creek, ...	0·66	6	0·45	2·99
Hanmer Springs	1·34	12	0·44	3·56
Highfield, Waiau	1·09	7	0·45	2·50
Gore Bay	1·14	8	0·51	2·80
Christchurch	1·99	17	0·85	2·68
Timaru	2·27	14	0·66	1·75
Lambrook Station, Fairlie ..	1·61	6	0·69	1·90
Benmore Station, Clearburn ..	1·17	10	0·41	1·85
Oamaru	2·19	14	0·71	2·01
Queenstown	0·67	16	0·37	2·32
Clyde	0·46	5	0·19	0·93
Dunedin	3·44	13	1·23	3·16
Wendon	1·88	11	0·41	2·50
Gore	1·99	13	0·30	2·83
Invercargill	1·70	18	0·31	3·68
Puysegur Point	4·65	17	0·82	6·47
Half-moon Bay	3·11	17	0·52	4·79

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith Letters should be addressed to the Editor.

CONTROL OF WIRE-WORMS.

H. K., Te Waewae :—

I have been informed that burnt lime destroys wire-worms. If so, would it do to plant potatoes with it ? How would fallowing the ground for a season act on the worms, and what methods do you suggest to deal with them generally ?

The Fields Division :—

Wire-worms are one of the most difficult insect pests to destroy. They are general plant-feeders, and do not confine their deprecations to one kind or family of food plants. This makes them more difficult to combat, as they cannot be evaded by altering the rotation. The control measures which are recommended as being the most likely to check wire-worms are the ploughing up as early as possible (the earlier the better) of grassland that has to carry a new crop, as the ground is then in a firmer condition at seeding-time, and thus not in a favourable condition for the egg-laying females. Gas-lime and salt have both been recommended as dressings for land prior to the ground being ploughed, but it is doubtful if these substances have any really beneficial effect. Burnt lime may check wire-worms to a small degree, but if the infestation is bad no material results will be obtained. You will thus observe that on a farming scale there is little one can do practicably in the way of checking the pest, and we would advise you to plant your potato crop on land which you know to be comparatively free from the pest.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 18th May to 29th June, 1933, include the following of agricultural interest :—

No. 70178 : Spreader for spray compositions ; Hercules Glue Co., Ltd. No. 70200 : Castrating forceps ; F. Veglia. No. 69028 : Field scarifier, J. W. Bayer. No. 69875 : Fungicide ; Electro Chemical Processes, Ltd. No. 70023 : Manure sower ; J. B. Whisker. No. 70175 : Milking appliance ; C. G. Howse. No. 70201 : Spraying insecticidal liquids ; Asiatic Petroleum Co., Ltd. No. 69082 : Treating timber ; H. L. Murray.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.

Hernings Swede.—In a farm trial at Washdyke, Canterbury, last season, Hernings club-root resistant swede was eaten right down by sheep, while rows of several other varieties were only partly used by the stock.

Co-operation in Wheat Research.—" Co-operation with Lincoln College, with the Lincoln Pure Seed Station, and with the Department of Agriculture was fully maintained," remarks the third annual report of the Wheat Research Institute, " and the complete accord of the workers in the various institutions dealing with wheat-growing in New Zealand is acknowledged as a great source of strength to the Institute."

Poultry Congress.—The Fifth World Poultry Congress, together with a related exhibition, will take place at Rome from 6th to 15th September next. The Italian Minister of Agriculture and Forestry will be President of the Congress, and Mr. W. A. Kock (President of the World Poultry Science Association) first acting Vice-President.